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ECONOMIC GEOGRAPHY

OCTOBER

THE GREAT BASIN
J. F. Bogardus, *Geographer*, Wharton School of Finance and Commerce

THE SUGAR INDUSTRY OF MAURITIUS
C. J. Robertson, *Geographer*, Istituto Internazionale d'Agricoltura, Rome, Italy

AGRICULTURE AND COMMERCE OF UGANDA
Earl C. Case, *Geographer*, University of Cincinnati

LOWER RIO GRANDE VALLEY OF TEXAS
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LAND UTILIZATION IN THE ST. FRANCIS BASIN
Sam T. Bratton, *Geographer*, University of Missouri

THE LIME INDUSTRY AT ROCKLAND, MAINE
rant E. Finch, *Geographer*, State Normal School, Danbury, Connecticut, and George F. Howe, *Geographer*, State Normal School, New Britain, Connecticut

MOUNTAIN TOPS AND LOWLANDS OF COLOMBIA
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GLACIAL TOPOGRAPHY AND AGRICULTURE IN CENTRAL MASSACHUSETTS
Berton R. Millington, *Geographer*, Brown University

LARK UNIVERSITY, WORCESTER, MASSACHUSETTS, U.S.A.

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CONTENTS FOR OCTOBER, 1930

	Page
THE GREAT BASIN J. F. BOGARDUS, *Geographer*, Wharton School of Finance and Commerce	321
THE SUGAR INDUSTRY OF MAURITIUS C. J. ROBERTSON, *Geographer*, Istituto Internazionale d'Agricoltura, Rome, Italy	338
AGRICULTURE AND COMMERCE OF UGANDA EARL C. CASE, *Geographer*, University of Cincinnati	352
LOWER RIO GRANDE VALLEY OF TEXAS WILLIAM T. CHAMBERS, *Geographer*, Stephen F. Austin State Teachers College	364
LAND UTILIZATION IN THE ST. FRANCIS BASIN SAM T. BRATTON, *Geographer*, University of Missouri	374
THE LIME INDUSTRY AT ROCKLAND, MAINE GRANT E. FINCH, *Geographer*, State Normal School, Danbury, Connecticut, and GEORGE F. HOWE, *Geographer*, State Normal School, New Britain, Connecticut	389
MOUNTAIN TOPS AND LOWLANDS OF COLOMBIA ALBERT C. SMITH, *Assistant Curator*, New York Botanical Gardens	398
GLACIAL TOPOGRAPHY AND AGRICULTURE IN CENTRAL MASSACHUSETTS BERTON R. MILLINGTON, *Geographer*, Brown University	408
BOOK REVIEWS	416

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ECONOMIC GEOGRAPHY

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THE GREAT BASIN

J. F. Bogardus

Geographer, Wharton School of Finance and Commerce

THE Great Basin includes an area of about 200,000 square miles lying in the Basin and Range Division between the Rocky Mountains and the Sierra Nevadas. Its shape is nearly that of an isosceles triangle; its northern side lies along the divide of the drainage basin of the Columbia River, its eastern side along the divide of the drainage basin of the Colorado River, and its western side in the central part of the Sierra Nevada crest. Included within its boundaries are almost the whole of Nevada, the western half of Utah, the southwestern corner of Wyoming, the southeastern corner of Idaho, a large area in southeastern Oregon, and much of southern California together with a strip running along the eastern border of that state.

It is one of the most interesting and picturesque sections of the United States and might well be termed, "The Land of Contrasts." The brilliant green of its irrigated valleys is in striking contrast to the brown and grey waste of its deserts. It contains some of the least valuable land in our country and yet hidden within the bare fastnesses of its mountains are deposits of gold, silver, copper, and other rare and valuable minerals. It has an eerie beauty which allures and fascinates one to the extent that it is not easily forgotten. Hundreds have perished of thirst in its deserts and yet here are found the prehistoric homes of a vanished race, the cliff dwellers, who are supposed to have sought refuge within its borders. To the protection of its isolated oases fled the Mormons seeking a land where they might live their own lives free from persecution. To one who travels through any of its desert regions it becomes a never-to-be-forgotten land. To look out across its vast stretches of sand, dotted with cactus and sagebrush, to watch the heat waves vibrate under the rays of a noonday sun, and to see the little dust devils whirled hither and yon near the base of its brown, cardboard mountains, is a sight which cannot be found elsewhere in the United States.

Within its borders it contains the remnants of our last frontier. In certain sections is to be found almost the last of the open range over which the cattle barons still exercise something of their old domination. Many of its remote regions have never been fully charted or explored. Its barren mountains still conceal deposits of valuable metals which from time to time are unearthed by the prospector. The Indians living within its bound-

FIGURE 1.—Typical desert scene in Nevada. (Courtesy of Bureau of Reclamation, U. S. Dept. of Int.)

aries still carry their dead into its fastnesses for burial in unknown graves and by weird ceremonies attempt to propitiate the evil spirits which lurk in its mountains. But even this frontier is passing. Where water makes irrigation possible the open range is being broken up into small farms. Its remote parts are being charted, its mineral resources are being rapidly exploited, and even cities have sprung up in its more accessible regions. But its vast desert areas remain, and must always remain, largely untouched to charm and allure the traveler who ventures within the range of their spell.

PHYSIOGRAPHY

Water is the dominating factor in the life of the Great Basin. The existence of it means irrigation, a relatively dense population, and prosperous communities, while its absence means uninhabited desert or at the most extensive grazing supporting a very sparse population. Unfortunately water is extremely scarce in the Great Basin. The High Sierras shut off the rain-bearing winds from the Pacific and the Rocky Mountains to the east prevent the cylconic storms from bringing any moisture from that direction. Thus, the rainfall is very slight varying throughout most of the area from five to ten inches per year. For example, Reno, Nevada, located near the western side of the Basin, has an annual average precipitation of 8.7 inches. Most of the precipitation which does occur takes place on the slopes of the mountains bordering the Basin or on the highest of the Basin Ranges. Much of this comes in the form of snow and it is among these snowfields that most of the Basin streams have their origin.

This lack of rainfall has given to the Great Basin certain arid characteristics which are almost unique in the United States. Interior basins, streams which disappear in piedmont slopes and salt lakes characterize the region. It is entirely an area of interior drainage, that is, none of the water within its borders reaches the ocean by surface drainage. The majority of the water brought down from the mountains by the streams is absorbed or evaporated and such water as remains collects on the basin floors in the form of salt lakes.

Thus, the Great Basin is really a collection of interior drainage basins in which arid characteristics are most marked.

In a region of this type erosion is pronounced and as the streams have no outlet to the ocean, the material

FIGURE 2.—Lahonton Dam, Newlands Irrigation Project, Nevada. (Courtesy of Bureau of Reclamation, U. S. Dept. of Int.)

which they carry is deposited on the valley floors often to a depth of from one to three thousand feet. This process if continued will ultimately result in the formation of a plain, and although in most sections the plain-forming process is still in its early stages, most of the valley floors are broad and flat.

The streams which have their rise in the bordering mountains and in the Basin Ranges, having no outlet to the sea, spread out over these valley bottoms forming shallow lakes. As the water of these lakes is evaporated a dense brine of common salt, sodium sulphate, and alkali remains. Great Salt Lake, for example, is said to contain some 400,000,000 tons of common salt and the solution is so dense that one may float in it without sinking. Many other lakes of the Great Basin are of this same type, these include Humbolt Lake, Carson Lake, and the lakes of central Oregon. Some of the Basin lakes are, however, of clear water, among these being Utah Lake, Bear Lake, and Lake Tahoe. The latter, located in the Sierras, is one of the most beautiful lakes in the United States. The sweetness or pureness of the lakes is determined by the existence or non-existence of an uninterrupted outlet; those lakes having an uninterrupted outlet contain fresh and sweet water, while those having an interrupted outlet or no outlet at all contain salt and other materials in varying amounts.

An interesting feature of most of the Basin Lakes is their constantly changing size and temporary character. The flatness of the valley floors causes them to be very large but very shallow. In many cases water exists in these lakes only during periods of high water and when this period has passed they evaporate, rapidly exposing broad expanses of mud flats known as "Playas." For instance, "Black Rock Desert in northwestern Nevada becomes in the spring rains 450 square miles of lake only a few inches in depth. But soon it is shining white with the crystals of alkali that remain after the water has dried up, leaving a typical 'alkali flat.'"[1] Even the lakes that are permanent vary greatly in size. The Great Salt Lake has expanded and contracted with changes in rainfall. "Since definite knowledge of the lake began, in 1850, there have been five periods of increase and four of decrease. The summer levels of 1868 and 1877 were more than 10 feet above the summer level of 1850, and those of 1903 and 1905 were 4 feet below those of 1850. The level of 1914 was 6 feet above that of 1905."[2] During the Glacial Epoch the cold retarded evaporation and the

[1] Smith, J. R., "North America," p. 510.
[2] U. S. Geological Survey, Bulletin 612, p. 96.

water level rose until two lakes of tremendous size occupied the Great Basin. To the eastern one of these lakes, geologists have given the name of Lake Bonneville, and to the western one, Lake Lahontan. When Lake Bonneville attained its maximum size, it was comparable in depth and extent with Lake Michigan and the water level rose more than 1,000 feet above the present level of Great Salt Lake. "About the borders of Great Salt Lake may be seen shore features associated with the ancient lake levels and still in almost perfect state of preservation. Upon the surrounding slopes and up to elevations of 1,500 feet above the surface of Great Salt Lake are well-defined deltas, bars, beaches, spits, capes, cliffed promontories, and bottom deposits, all formed by or associated with ancient lakes whose waters once stood at these high levels."[3] The waters rose so high that they flowed out through Red Rock Pass into the Portneuf River, a tributary of the Snake River, which in turn is the chief tributary of the Columbia. Thus for a time the Bonneville Basin became part of the drainage system of the Pacific Ocean. Lake Lahontan also attained large size but never rose sufficiently high to have an outlet. Thus, in the past the water level of the Basin lakes has risen and fallen in response to changes in precipitation and evaporation. Recently, an additional factor has also influenced the water level; this factor is the diversion of water from the streams for the purpose of irrigation. These three factors today determine the size of the Basin lakes and a change in any or all of them would exert a profound change on the amount of water they contained and consequently upon the life of the region.

FIGURE 3.—Curve on the High Line Canal, Strawberry Valley Irrigation Project, Utah. (Courtesy of Bureau of Reclamation, U. S. Dept. of Int.)

As has been previously pointed out, the rivers of the Great Basin receive most of their water from the melting snows of the mountains. As a consequence the stream flow is variable, the maximum occurring during the late spring and early summer months when the snow is melting, with a decrease during the summer months and a minimum during the winter. Many of the streams entirely disappear during the dry period. In a few cases lakes serve as natural storage reservoirs and the streams which flow from them have a fairly regular run-off. This is true of the Carson and the Truckee and a few other streams descending from the Sierra Nevadas and the Wasatch Mountains. However, as only a small portion of this area has been glaciated, lakes are scarce and most of the streams, especially those rising in the Basin Ranges, are variable as to length and discharge.

Other features of the Great Basin which are of interest are the roughly parallel mountain ranges which cross it from north to south. Geologists

[3] Bowman, Isaiah, "Forest Physiography," p. 214.

tell us that these ranges are the results of faulting of great blocks of the earth's crust. These blocks have been turned up on edge, and as a consequence, the mountains have a sharp crest with steep slopes on one side and gentle slopes on the other. These ranges appear to be oldest in the south where erosion has caused much of their original outline to disappear. In the north they are of most recent origin and their original form has been but slightly changed. There are also many evidences that faulting still continues in these Basin Ranges. In a few cases these mountains are high enough to catch sufficient moisture to support tree and grass growth, and where this is the case, they are frequently used as summer pastures.

The soils of the Great Basin are made up of a great variety of rock and consist of wash from mountain slopes, shore deposits associated with ancient lakes, recent stream valley sediments and river delta deposits. Part of these soils are rendered useless by the accumulation of alkali or seepage waters, but where this is not the case and where water is available for irrigation they are of great agricultural value. From the agricultural point of view the best soils are those along the valley bottoms and stream sediments in the vicinity of river flood plains. These occur in low or slightly elevated valleys which have a smooth or gently rolling surface.

The physiography of the Great Basin is thus of great interest to those familiar with geology or physical geography. Its interior drainage with its salt lakes of varying size, its block-faulted mountains which contain evidences of recent faulting, and its variable rivers frequently disappearing into piedmont slopes tend to make it a physiographer's paradise and a veritable treasure-mine to all who are interested in our physical environment.

RESOURCES AND INDUSTRIES

As Nevada and Utah are the states having the greatest portions of their areas lying within the Great Basin, and as within their boundaries are to be found conditions typical of all parts of the Basin, the present discussion covering resources and industries will be limited to those two states.

NEVADA—SIZE AND GENERAL CHARACTERISTICS

Nevada is the sixth state in the United States in size having a total area of 110,690 square miles. Almost its entire area lies within the boundaries of the Great Basin and it is probably the most typical of the Basin states. The barrier of the Sierra Nevadas to the west has so reduced the rainfall that by far the largest part of the state is arid and desert land. It is the great dry plains of Nevada, dotted here and there with clumps of bunch grass, that form almost the last of the open range. Hidden within its brown-faulted mountains, Nevada holds large deposits of gold, silver, copper, and other valuable ores. These two industries, namely stock-raising and mining, are dependent upon natural conditions which are found widely throughout the area of the Great Basin. Her people also seem to have absorbed something of the spirit of the desert and to combine within themselves certain desert characteristics which, while picturesque and fascinating, have not always worked out to the best interests of the state.

POPULATION

As to the population, Nevada is the most empty state in the United States. Although ranking sixth in size, it has consistently held the lowest position with regard to the number of inhabitants. According to the Federal Census of 1920 Nevada contains about 77,000 people and this marks a decline of over 5 per cent since 1910. The reasons for this decline are to be found in the character of the population and in the mining and agricultural development of the state.

The population is largely made up of whites with a few Indians, negroes, Japanese, and Chinese. The white element contains a large number of shifting, single laborers. They come to work for a time in the mines or on the ranches and then pass to other fields, or they may come to build homes, but discouraged by the scarcity of water or the antagonism of the cattlemen, they move to a more hospitable area. The seriousness of this situation is illustrated by the fact that only 32 per cent of the population is born within the state itself. The reasons for this shifting population may be found in various elements of her life, such as the efforts of the ranchers to prevent the break-up of the range and the fluctuating character of the mining and ranching industries. But whatever the cause, the seriousness of the situation cannot be denied for it deprives the state of stable, skilled labor and brings to it a class of men who do not, as a rule, make the most desirable citizens.

The school system has in the past been backward, but at present this condition is being improved and it is hoped that within the near future the state will rank well in educational facilities.

FIGURE 4.—Wheat ready for harvest, Newlands Irrigation Project, Nevada. (Courtesy of Bureau of Reclamation, U. S. Dept. of Int.)

Nevada has only one city of any importance, namely, Reno, which in 1920 had a population of 12,000. The small importance of the towns and cities may be seen from the fact that only 19 per cent of the population is urban.

Nevada thus has a population much smaller than that of Camden, New Jersey, and one which fluctuates with the ups and downs of the mining and ranching industries. A considderable portion of this consists of shifting labor which takes little, if any, interest in the development of the state. Here then is one of the chief problems which faces the state, and unless these conditions can be remedied, there seems to be little hope of any great progress in the future.

AGRICULTURE

General agriculture is not of great importance in Nevada. In 1925 there were 4,090,586 acres in farms or 5.8 per cent of the land of the state. This marks an increase of 1,733,423 acres over the amount in farms in 1920. However, only about 13 per cent of this farm area is classified as

crop land, the remainder being mostly pasture. The arid character of the state has made it necessary to keep the farms large and the average acreage per farm in 1925 was a little over 1,053 acres, and the average value of all farm property per farm in the same year was $25,260. The principal crops according to acreage in 1924 were hay and forage, wheat, barley, white potatoes, oats, and cantaloupes, in the order named. The acreage of all of these crops with the exception of barley decreased between 1919 and 1924. Some fruit, including apples, peaches, pears, plums, and grapes, is also raised. It is thus evident that general agriculture is not of great importance in Nevada, and although there has been an increase in farm lands, the majority of that increase is in pasture land and not in crop land.

FIGURE 5.—First-class stand of alfalfa ready for cutting, Newlands Irrigation Project, Nevada. (Courtesy of Bureau of Reclamation, U. S. Dept. of Int.)

Because of the dryness of the climate 94.4 per cent of the improved land in Nevada is irrigated. The acreage irrigated in 1920 was 561,447, which marked a decrease of 20 per cent in the irrigated acreage since 1910. The principal streams used for irrigation are the Humbolt River, which rises in the northeastern part of the state and flows in a southwesterly direction and the Truckee, Carson, and Walker Rivers which rise in the Sierra Nevadas in California and flow in an easterly direction. The largest irrigation project in the state is the Newlands Project of the United States Reclamation Service. This uses the waters of the Truckee and Carson Rivers to irrigate the plains around Carson City where it is hoped that in the future some 230,000 acres will be brought under irrigation. Although water is available for irrigating only a small fraction of the state, yet the present irrigated acreage can be considerably expanded. Such expansion provides the only real possibility for the extension of cultivated agriculture, and will aid the state by attracting to it a home-owning, industrious type of citizen who will take a real interest in state affairs.

LIVESTOCK

The raising of livestock is a very important industry in the state, the total value of all livestock being $26,373,528 in 1925. Cattle and sheep raising are the most important, but in addition to these horses, swine,

and chickens are raised in some quantities.

There were in 1925 some 1,183,500 sheep in Nevada and these produced approximately 8,000,000 pounds of wool. This marks a considerable increase both in the number of sheep and the amount of wool over 1910 and 1920. There were in the same year some 419,000 cattle of which 17,380 were dairy cows. This marks a slight decline in the number of cattle since 1910, but shows a decided increase in the number of dairy cows. This has been accompanied by an important increase in the production of dairy products. Cattle and sheep raising are carried on extensively on the open range. In summer many of them are taken up into the mountain pastures and in the winter they are brought down into the valleys where some forage crops are frequently produced to tide them over the dry season. Cattle raising is at once a strength and a weakness to the state. It is today Nevada's second most important industry, but it is an industry which in part has retarded the growth of more general agriculture and has aided in maintaining the large shifting population of the state.

FIGURE 6.—Strawberry patch near Fallon, Newlands Irrigation Project, Nevada. (Courtesy of Bureau of Reclamation, U. S. Dept. of Int.)

Much of the state will never be suitable for anything but stock raising and large areas are not even suitable for that, but in many sections the soil is very fertile and, where irrigation is possible, will grow large crops. If these sites can be used for irrigation, a class of home builders will come in who will not only add to the wealth of the state by their products but will tend to stabilize its population and give to Nevada an increasing group of citizens who will be vitally interested in her welfare. Present indications point to the fact that this change has begun and it is hoped that it will continue steadily.[4]

MINING

It was the search for mineral wealth which led to the first white settlements in Nevada. Since 1859 when the famous Comstock Lode, one of the world's most notable silver mines, was discovered, the mining industry has expanded and contracted with the discovery of new deposits

FIGURE 7.—Registered Jerseys, Newlands Irrigation Project, Nevada. Note the desert in the distance. (Courtesy of Bureau of Reclamation, U. S. Dept. of Int.)

[4] Statistics concerning agriculture were taken from the U. S. Census of Agriculture, 1925, Nevada, Statistics by Counties.

and the working-out of old ones. These fluctuations have caused corresponding variations in the population and the prosperity of the state. Similar fluctuations have been caused by changes in world prices of the various metals mined. For example, the total value of the gold, silver, lead, and zinc produced rose to $54,424,580 in 1917, fell to $12,137,536 in 1921, rose to $25,040,349 in 1923, and in 1926 was $24,549,991. Within recent years gold and silver have been decreasing in importance while copper, lead, and zinc have been becoming more important. Copper especially has increased in importance within recent years. Normally, Nevada holds second rank among the states in the value of the products of its gold and silver lode mines, sixth place in the production of copper and eleventh place in the production of lead and zinc.

Today deserted mining towns mark the sites of once thriving centers, but as old communities die new ones spring up, and it seems likely that important new deposits of minerals will be found in the future and that mining will remain one of the most important industries in Nevada.

MANUFACTURING

Nevada is comparatively unimportant in manufacturing, ranking forty-eighth among the states in this respect. Her most important industries are car and construction shops, slaughtering and meat packing, and printing and publishing. Metallurgical industries are also of increasing importance. These include smelting and milling plants for the recovery of gold and silver by amalgamation and cyanidation. However, the development of the state in manufacturing will never be great as it lacks such important factors as power, labor, and markets. Such manufacturing as does develop will probably be concerned with satisfying certain local needs and in preparing the products of the mines and farms for transportation to other centers.

SUMMARY

Nevada has not increased rapidly in importance and has actually shown a decline in certain lines. Although economically it will never take an important place among the states of the United States, yet it has possibilities of improving its present status. If its water is made available for irrigation and settlement encouraged, the prosperity of the state will be advanced from both a human and a material point of view. The development of Federal Projects on the Colorado River seem likely to considerably increase the possibilities of irrigation within the state. Its future undoubtedly lies in irrigating such land as is possible, in continuing the raising of livestock, and in the continued development and expansion of its mining industry. However, the majority of the land must ever remain a desert, and although picturesque it will add little if anything to the wealth of the state.

UTAH—SIZE AND GENERAL CHARACTERISTICS

The development of Utah has been in marked contrast to that of Nevada. The state has progressed steadily making excellent use of its resources and as a consequence we find here a thriving, growing community which is making its influence felt over an increasingly wide area. The chief causes for the differences in the development of these two states lie in the better natural resources and different type of popu-

lation to be found in Utah. This state illustrates the fact that sections of the Great Basin contain factors which, if properly utilized, can support a prosperous community.

Utah ranks tenth among the states in size, having a total area of some 85,000 square miles. The western half of the state lies within the Great Basin. To illustrate this in another way, seventeen of its twenty-eight counties lie wholly or in large part within the Basin section.

The state contains many interesting features. One of the most important of these is the Great Salt Lake which is the largest inland body of salt water in the United States and the largest body of water within the Great Basin. On the shore of this lake is Salt Lake City, the capital of the state and the largest city within the state or within the Basin. Southwest of this lies the wide expanse of the Great Salt Desert which shares with the Mohave Desert the distinction of being the largest and most interesting desert region in the Basin and in the United States.

The state is similar to Nevada in that the entire region is arid with the exception of the higher elevations, but it differs from Nevada in that it contains much larger areas of land suitable for agriculture and has larger water supplies for irrigation.

POPULATION

Utah was settled by the Mormons who still comprise the most important population element within the state. They are hard working and industrious, and with them the community spirit has been developed to a marked degree. Their characteristics have had a dominating influence upon the development of the state. Their early leaders caused the attention of these people to be directed towards agriculture so that they built up stable communities before their mineral resources were exploited. According to the Census of 1920 Utah had a population of 450,000, and in this respect it held twentieth rank among the states.

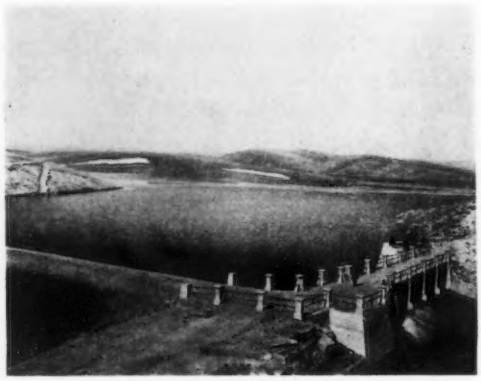

FIGURE 8.—Strawberry Dam and reservoir, Strawberry Valley Irrigation Project, Utah. (Courtesy of Bureau of Reclamation, U. S. Dept. of Int.)

Over 98 per cent of the population is white and by far the largest part of it is native American stock. Such foreign elements as are found come chiefly from central and northern Europe.

The state contrasts with Nevada in the fact that its population is quite stable, 69.9 per cent of its people being born within the state. It is thus not faced with the problem of a large supply of shifting laborers.

The school system and educational program of the state are excellent. In this connection it is interesting to note that 88 per cent of the state's revenues are spent for educational purposes. The result is shown in the unusually low percentage of illiterates, this being 2.5 per cent in 1920.

About half of the population of the state is urban, and there are three cities each containing 10,000 people or over. These cities are Salt Lake City with a population of 118,110, Ogden

with a population of 33,000, and Provo with a population of about 10,000. These statistics of population are from the Federal Census of 1920. All of these cities are to be found in the portion of the state lying within the Great Basin.

The character of the population is an important factor in explaining the excellent growth and development of the state. The continuation of this growth is indicated by the fact that the population increased 20.4 per cent from 1910 to 1920 and that this increase was composed largely of those who came to Utah to make the state their home.

AGRICULTURE

In agricultural development Utah also presents a marked contrast to Nevada. Although the state has on the western slopes of the Wasatch Mountains better agricultural territory than is to be found in Nevada and although these mountains furnish an excellent supply of water for irrigation, yet it has done more to utilize its resources than has its neighbor. As in Nevada, stock raising is here carried on in sections too dry for the production of crops.

About 10 per cent of the land of the state is in farms and about 29 per cent of this amount is classified as crop land, the remainder being largely pasture. The largest part of this farm land lies within the Great Basin. Farming is on the increase, as may be seen by the fact that farm acreage has increased from 3,397,699 acres in 1910 to 5,000,724 in 1925. As diversified farming is extensively practiced, the farms are of normal size averaging 192.4 acres in 1925, and over 89 per cent of them are operated by owners.

The value of all the crops in 1927 amounted to $39,000,000, and the value of those produced in the Great Basin was about $32,000,000. This valuation marks a considerable increase over 1910 but marks a decrease of $19,000,000 from the value of the crops produced in 1919. By far the most valuable crops of the state are hay and forage. The value of these amounts to about 37 per cent of the value of all crops and they also occupy the largest acreage. Next in importance comes wheat, and this is followed by sugar beets in which Utah holds a high place. Oats and corn are also of considerable importance. Utah produces large amounts of fruit and vegetable products, among the most important of which are apples, cherries, grapes, peaches, potatoes, peas, tomatoes, and onions. Potatoes alone represented a value of $2,228,000 in 1927. Fruits are to be found on the foothills and slopes of the Wasatch Mountains and are of increasing importance.

The soils of Utah are rich and well mixed, often extending to a depth of 40 feet. Where sufficient moisture is available or where irrigation is possible these soils produce large and valuable crops. Utah ranks among the leading states in the production per acre of such crops as sugar beets, spring wheat, potatoes, barley, and alfalfa. As the majority of these crops are grown within the Great Basin, this illustrates the fertility of the Basin soils if they are well cultivated and irrigated.

A few of the grain crops, especially winter wheat, are grown by dry farming methods, but because of the dryness of the climate 80 per cent of the improved land of the state is irrigated. In 1919 the irrigated acreage was 1,371,000 acres, and it has increased slowly but steadily since that time. With the extension of irrigation projects, Utah will become

more important as an agricultural producer, but it is well to remember that only a small portion of the state can ever be irrigated.

LIVESTOCK

While stock raising has not the relative importance in Utah that it has in Nevada, yet this state surpasses its neighbor in the number and value of its livestock. The total value of the stock within the state was $48,018,867 in 1925. Sheep raising is the most important item both as to numbers and value. In 1925 there were 2,355,038 head of sheep within the state and these produced between eighteen and nineteen million pounds of wool. Cattle raising ranks second in importance, and over half a million head were to be found in 1925. This included over 71,000 dairy cows and here, as in Nevada, the number of dairy cows has been increasing steadily within recent years. Horses rank third in importance, there being 110,172 head with a value of $5,155,772 in Utah in 1925. Sheep, cattle, and horses are extensively grazed on the open range, consisting of Federal and state lands, and are frequently taken up into the mountains for summer pasturage. Some grazing is done within the National Forests included within the state. Poultry is an item of livestock which has recently been increasing rapidly in importance. The value of the chickens raised in 1924 was $933,074 and the value of the eggs produced in that year was $2,518,304.

FIGURE 9.—Digging sugar beets on Mapleton Bench, Strawberry Valley Irrigation Project, Utah. (Courtesy of Bureau of Reclamation, U. S. Dept. of Int.)

FIGURE 10.—Barley produced under irrigation near Provo, Strawberry Valley Irrigation Project, Utah. (Courtesy of Bureau of Reclamation, U. S. Dept. of Int.)

Mules, goats, and swine are also raised in some quantities. Stock raising is thus found and will continue to be found in those sections of the state which are too dry for the production of crops. However, within recent years there has been an increasing amount of livestock raised in the irrigated districts in connection with diversified farming. Even the large ranches irrigate considerable acreages of alfalfa which is fed to the stock during the winter.

MINING AND QUARRYING

Mining is the second most important industry in the state and Utah ranks eighteenth among the states in the value of her mineral products. The Basin ranges of Utah are rich in ores and new deposits are constantly being opened up. In 1927 Utah ranked first among the states in the production of silver, furnishing 32.05 per cent of the nation's total; second in copper, producing 15.48 per cent of the nation's total; second in lead, producing 22.42 per cent of the nation's total; and sixth in gold, producing 8.85 per cent of the nation's total. The largest open-cut copper mine in North America is located at Bingham, twenty-five miles from Salt Lake City. The state also contains the largest silver mines in the United States. The production of the various minerals fluctuates from year to year, depending upon the working-out of old deposits, the opening up of new ones and variations in market prices. For example, the total value of the gold, silver, copper, lead, and zinc rose to $99,328,155 in 1917, fell to $22,023,790 in 1921, and gradually rose again to $82,662,884 in 1926.

Considerable deposits of bituminous coal are to be found within the state, but mostly within areas not included in the Great Basin. The United States Geological Survey estimates that 13,130 square miles have workable coal deposits and estimates that these deposits contain some 196,000,000,000 tons. The annual production today is around 4,750,000 tons and is increasing steadily.

In southwestern Utah, in Iron and Washington Counties, are important deposits of iron ore. The United States Geological Survey estimates that development work has disclosed 40,000,000 tons of ore, and estimates as to the total amount run as high as 1,000,000,000 tons. These deposits

have only been worked extensively since 1922 and their production should increase yearly.

Utah contains large deposits of fine building stone. Granite, sandstone, and marble are quarried extensively. There are also large deposits of gypsum which is used in the manufacture of the so-called "hard wall plasters." Large amounts of natural gas have been found and there are indications of oil though little has been produced up to the present. The United States Geological Survey estimates that there are 92,159,000,000 tons of oil shale in the state which should yield nearly 15 gallons to the ton. Extensive deposits of potash are also found, but at depths too great to make mining profitable at present. Salt is mined from open cuts in Sevier and Sanpete Counties, but the principal production comes from the waters of the Great Salt Lake. It is estimated that this lake contains 400,000,000 tons of common salt and considerable amounts are taken from it each year.

FIGURE 11.—Open cut copper mines at Bingham, Utah. (Courtesy of Richard N. Hunt.)

From this discussion it is clear that Utah is favored in having valuable and extensive mineral deposits. In the production of gold, silver, copper, lead, and zinc, the state is among the foremost in the country and the production of the last three minerals is increasing rapidly. The coal deposits furnish an ample source of power and will become increasingly important in the future. Iron ore should play an important part in the future industrial development of the state. The production of building stone, gypsum, and salt seem likely to maintain their present importance at least. Such minerals as oil shale and potash offer tremendous possibilities for the future. With the exception of a majority of the coal, all of these minerals are produced within the Great Basin and are typical of important deposits to be found within that area.

FORESTS

Utah contains forest areas of considerable extent, but in these areas, because of the arid character of the region, the growth is not heavy and the trees are not of particularly valuable types. The majority of these areas are contained within National Forests which occupy seven and one-half million acres throughout the state. It is estimated that these forests contain between seven and eight billion feet of timber. The trees most commonly found are the western yellow pine, lodgepole pine, Engelmann spruce, Douglas fir, and white fir. The majority of this forest is found among the Wasatch Mountains, and its value lies not only in the actual timber produced but also in its affect upon the stream flow from this mountain area.

By far the majority of the Basin ranges are desert and support only a scanty growth of sagebrush and juniper. However, a few of the ranges which are sufficiently high to receive moisture have an open forest growth. These ranges have an upper and a

lower timber line; the position of the upper timber line is determined by cold and that of the lower line by the lack of moisture. Although sufficient timber is found to supply the needs of those living within the Great Basin, aridity will prevent this from ever becoming an important timber area.

MANUFACTURING

Although Utah has two factors necessary for successful manufacturing, namely, power and raw materials, it lacks at present extensive markets and a large labor supply. For this reason the industrial development of the state has been slow, and it normally ranks about fortieth among the states in this respect. The position which manufacturing holds is shown by the fact that the estimated value of the manufactured products of the state in 1927 was $325,000,000.

The principal types of manufacturing are those which utilize the raw materials of the state. In order of importance they are smelting, beet sugar refining, slaughtering and meat packing, and milling. Recently, also, the canning industry has been increasing in importance. Of this group the smelting and the beet sugar industries stand out as particularly important.

The manufacturing of the state has shown steady progress during recent years, and although Utah will in all probability never become an important manufacturing section, its progress in this connection will continue as population increases, new markets open up, and additional amounts of raw materials are produced.

The majority of the manufacturing of the state is to be found in Salt Lake City, Provo, and Ogden. These centers contain the only important manufacturing to be found throughout the Great Basin.

SUMMARY

Utah presents an example of the most effective use that can be made of the resources of the Great Basin. The thrifty and industrious population of the state have so utilized those resources as to produce a stable and prosperous community. It serves as an example which other sections of the Basin area might well follow.

Utah should develop in many lines, its mining industry is growing and should continue to grow, it can expect a moderate development in manufacturing, stock raising will become more important with the increased introduction of high-grade stock, and its agricultural development will continue as more and more land is irrigated. From five to ten million acres of land can be irrigated and this is being done as rapidly as possible. Thus, the future of Utah is indeed bright and holds great promise, but it is well to remember that here, as in Nevada, much of the land must remain a desert, unoccupied, and of little value to the rest of the state.

TRANSPORTATION

The growth and progress of Nevada and Utah, as of other sections of the Great Basin, have depended upon the development of modern transportation facilities. Prior to the construction of the railroads only the most precious metals were of sufficiently high value to bear the extremely heavy transportation costs to markets. All other products, both agricultural and mineral, had to depend upon local markets which were obviously small. Also, prior to such construction, it was impossible to bring into the Basin essentials demanded by any considerable population and which could not be there produced. Thus, it was not

until modern transportation facilities were provided that the Great Basin could secure the essentials for any considerable population or exploit the natural resources which it contained.

Today several great railroads and their subsidiaries give access to those portions of the Basin most suitable for agriculture and to the more important mineral-producing regions. These roads are the Union Pacific, the Southern Pacific, the Western Pacific, the Santa Fé, and the Denver and Rio Grande Western. The latter two, however, tap only small parts of the area. Large sections of the Great Basin, however, have no access to rail transportation and it is probable that this condition will continue to exist as many portions are so sparsely populated and produce so little that it would be unprofitable to construct railroads to them. Nevertheless, the railroads which have been constructed have made possible the development already described as they have enabled the producing areas to get their products to markets and have made it possible to secure supplies from the outside.

Four electric lines, centering around Salt Lake City, also serve part of the region.

Recently modern highway construction has advanced rapidly near the centers of population and such well-known interstate highways as the Lincoln Highway, the Victory Highway, the Zion Park Highway, the National Old Trails Highway, and the Highland Trail cross portions of the area. These roads add to the prosperity of the Basin by putting new sections into communication with markets and supplies.

Recently, also, air transportation has developed rapidly. Salt Lake City has become a center for numerous air routes connecting it with cities in all directions.

Thus the railroads, both steam and electric, the highways, and the air routes have made many sections of the Great Basin accessible and have played no small part in bringing about such development and prosperity as the area has attained.

CONCLUSION

The Great Basin is and will continue to be one of the most unique and picturesque sections of the United States. Its extreme aridity, due to the mountain barriers on each side, and its interior drainage system set it apart from all other sections of the country. The Great Salt Desert, the Mohave Desert, Death Valley (the lowest portion of the Basin), and the Basin ranges themselves are also sights which cannot be found elsewhere on the continent. Much of its area is and must always remain a desert which will be of little importance outside of its scenic beauty. The development within the state of Utah well illustrates the future lines of progress for those sections where development is possible. These lines are the continued development of the mining industry, the development of agriculture through the irrigation of all lands for which water is obtainable, the development of the livestock industry by the raising of high-quality stock on those sections which are sufficiently moist to support some grass growth, and the development to some slight extent of manufacturing to supply local needs and to utilize local raw materials.

However, to really know the Great Basin and to feel its spell, one must not only visit the more densely inhabited sections of Utah and Nevada but must venture into its wilder and more remote desert portions. To

slowly melt under a noonday desert sun; to lie in the chill of a desert night and to watch the millions of brilliant stars which seem almost within arms' reach; to see in the distance a cool and inviting lake and after wandering long in search of it to discover that it is but a mirage and to know that on such an occasion it is only a full water bottle that spells the difference between amusement and tragedy; to come suddenly around some rocky corner upon an old prospector and his burro and to stop for a few minutes while he expertly aims a stream of tobacco juice at a nearby puff adder and tells of his next strike; to do all of these things is to know the desert and without them one can little imagine its fascination. It is the desert which is and always will remain the principal part of the Great Basin, and it is difficult for those who have never visited it and who have only the background of the highly civilized centers of the east and the middle west to visualize it. But it is there, eternal, silently weaving its web of mystery and fascination, ever alluring, ever repelling, it is the spirit of the Great Basin.

THE SUGAR INDUSTRY OF MAURITIUS

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MAURITIUS, once primarily important to the British Empire as a strategic outpost in the Indian Ocean, owes its present-day significance to its position as the leading source within the Empire of Great Britain's imports of raw sugar, its exports of this commodity to Great Britain and Northern Ireland in the last few years having been exceeded only by those of Cuba, the world's leading producer. In the quinquennium, 1923–1927, while Cuba's proportion of our imports was 35 per cent, that of Mauritius was 14 per cent. In the same period the average annual production of Mauritius was 216,000 metric tons, of which an average of 165,000 came to this country. In attaining this level of production this little Colony of 705 square miles, much of it mountainous, has become an extreme example of a one-crop country. Sugar is indeed "la mère nourricière du pays." In the years following the War, sugar cane has occupied up to almost 80 per cent of the cultivated area, comprising the best lands. In 1921–1926 sugar accounted for 96 per cent in value of the total exports excluding specie. The determining influence of the crop on the life of the island is shown by a comparison of the course of sugar exports with that of the Government's revenue, and this only reflects its influence on all the activities, economic and social, of the Colony. Here, too, as in other "sugar colonies," those who control the industry have exerted a strong influence on local political affairs. While the Government augments its revenue in years when the sugar market is favourable, it has, on the other hand, rendered assistance from time to time to the industry on which its finances depend.

Distribution

The sugar cane was introduced by the Dutch but not cultivated commercially until after 1735.[1] It now occupies the greater part of the coastal districts of Savane and Grand Port on the southeast, the plains of Flacq on the east, and much of the northern districts of Rivière du Rempart and Pamplemousses, while a belt of cane estates runs across the central plateau, following the line of the more northerly of the two railways crossing the uplands. There is also a much smaller irrigated area in Black River near the west coast. Of the total area under cane over two-thirds are below the 600-foot contour, the higher districts which occupy over half the island being less favourable because of heavier rainfall and lower temperature.

Relation to Climatic Conditions

The sugar cane grows within wide limits of annual rainfall. In Mauritius approximately two-thirds of the total crop are grown between the annual isohyets of 50 inches and 100 inches. On the plateau precipitation is for the most part greater, the area of maximum lying rather to the south and east, facing the trade winds, which in summer blow from

[1] A. Walter in Macmillan's "Mauritius."

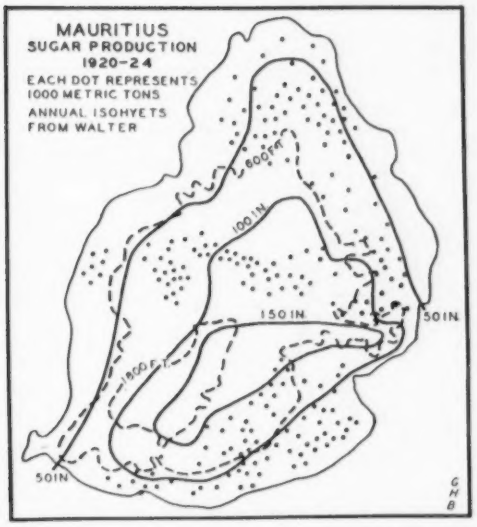


FIGURE 1.—Sugar production in Mauritius from 1920 to 1924.

east and east southeast, and in winter from east southeast and southeast. The eastern coastlands are thus hot and humid, the southeast being so even in winter, and Grand Port and Flacq in the south and east having the greatest area under cane. The western coastal areas are markedly drier, particularly in the Black River district, the precipitation there being 32 inches, falling chiefly in the period January to April, only 60 per cent being effective. Sugar cane is, however, grown in this district by means of irrigation. La Ferme Reservoir, completed in 1921, irrigates 3,000 arpents. La Nicolière system, in the North, which suffers from large fluctuations in yield, will irrigate over 10,000 arpents when its three connected reservoirs are completed. As usual, in irrigated areas, comparatively high yields have been obtained, the Black River district having two tons per arpent more than the average for the island.[2]

For sugar cane a wet season with fairly evenly distributed precipitation is necessary to secure a good yield of cane, while to ensure a good yield of sugar this should be followed by a dry season in which the sugar-content of the juice is increased. In Mauritius the well-marked alternation of wet and dry seasons due to the annual migration of the wind-belts is thus favourable to sugar production. The summer rains begin in December and rise to a maximum in March, after which there is a sudden falling-off in April and then a steady decrease in precipitation to the minimum in September. The sugar cane is perennial, producing for many years in succession fresh offshoots from the mass of underground stems, the first

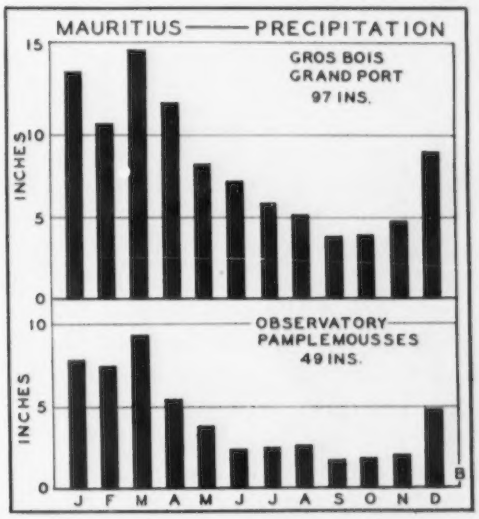


FIGURE 2.—Typical rainfalls for the wet Southeast (Grand Port) and the drier Northwest (Pamplemousses) in Mauritius. (Data from Walter, On the Influence of Forests on Rainfall. Period 35 years.)

season's cane being known as "plant cane," the succeeding offshoots as "ratoons." The number of years for which ratooning is allowed to go on varies in different countries. In Mauritius about four-fifths of the crop in any year is from ratoons.

[2] Mauritius Dept. of Agric., General Bulletin, No. 6.

The growing-period of the ratoons covers approximately the 12 months of the calendar year. About 75 per cent of an individual ratoon crop is produced in the four months of high temperature, January to April, when growth is very rapid. At this time, too, the crop is getting the summer rains. There is a rapid falling-off in rate of growth with the fall in temperature in the succeeding months. Ripening takes place in the relatively cool winter months from June onwards. The range of monthly mean temperature in Mauritius is from about 26.5° C. in February to about 20.5° C. in August. There is no danger of frost, which is the chief consideration in regard to the relation of cane to temperature.

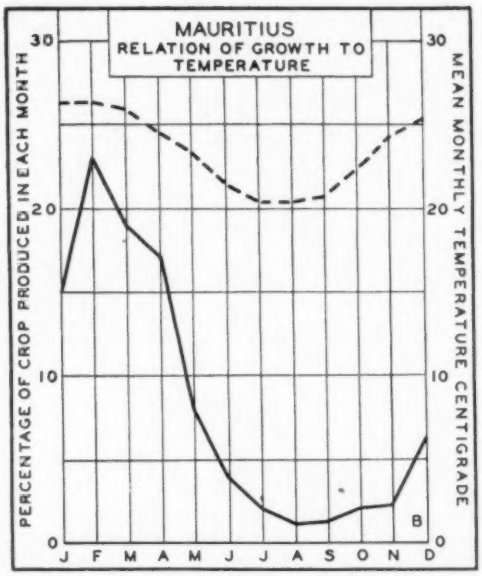


FIGURE 3.—Ratoon crop, maturing in twelve months, in Mauritius. (Data from H. A. Tempany, Mauritius Dept. of Agric., Gen. Bull. No. 36. 1926. Page 31.)

Practically all the plant cane is also harvested by December, after a growing season eighteen to twenty-two months, the Grande Saison. This cane gets the benefit of two rainy seasons and undergoes a resting period during the cool dry season from July to September of the first year, particularly in the higher districts where the cool season is more pronounced. There the plant cane takes longer to mature. In the northern lowlands it is ready, however, in thirteen to fifteen months and is harvested at the beginning of the crushing season in August, having been planted in April to June of the previous year. This is the "Petite Saison." This cane is sufficiently established to resist the first dry season and grows mainly in the following summer. The practice varies not only with climate but with soil, labour, and other local conditions, and there are transitional forms, such as "Demie Saison," with a sixteen to eighteen months' growing period, also harvested by the end of the calendar year. The highest yield comes from the "Grande Saison" crop, thus compensating for its greater time in the ground and the additional cost in cultivation. June is regarded as the best month for planting, the yield not only of the plant canes but of the subsequent ratoon crop being reduced if planting is delayed until after August. From the last days of July onwards, cane is being harvested in some part of the island, beginning on the northern lowlands with the "Petite Saison" crop, the main bulk of the total crop being crushed in the last three months of the year and the campaign being generally completed by the end of December.

In a detailed study [3] of rainfall in relation to yield of sugar, M. Koenig has shown that it is not the heavy summer rains of January–March that are important but the rainfall in

[3] Mauritius Dept. of Agric., General Bull. No. 27, pp. 11–12.

June and July (especially the latter) preceding the harvest, and that in November–December (especially the former) in the preceding year. A definite positive correlation has been established between the rainfall, or, still more precisely, the degree of wetness (which allows for the number of days during which rain falls), and the subsequent yield. Deficiency of rainfall during these critical periods cannot be subsequently compensated for. Similarly, in temperature, March has been shown to be the critical period.

The most calamitous vagary of the weather to which the island is subject is the particularly violent cyclonic storms that are especially prevalent in February and March. Although the paths of these storms, which are formed mainly in the area of intense heat to the north and northeast, very rarely pass over Mauritius, they occasionally pass sufficiently near to cause considerable damage, an approach to within 50 or 60 miles being dangerous, since the wind then blows with violence. The most disastrous of comparatively recent times were those of February 12 and April 29, 1892, the two together destroying 48.3 per cent of the sugar crop.[4] Next to these comes that of February, 1902, which destroyed 18.2 per cent; since then severe cyclonic damage has occurred in 1911, 1916, and 1926. The curve of annual production shows their incidence clearly. But, it is only when cylcones pass too near the island that their rôle is destructive; normally they are beneficial, for in their absence the rain-bearing winds are weak, and it has been found that droughts generally occur in years of weak cyclonic circulation. Despite the serious damage experienced by the sugar crop through cyclones, the exposure to cyclone risk has been one of the factors favouring the predominance of sugar cane in the island, owing to the relatively greater resistance offered to the wind by the cane as compared with other crops.

FIGURE 4.—Les Trois Mamelles, Mauritius. The picturesque remains of volcanoes rise from the cultivated plains of the interior. (Courtesy of Imperial Institute, London.)

The other natural calamity to which Mauritius is most subject is

[4] Mauritius Almanac, 1925–1926, p. E. 39.

drought. Since that of 1886 droughts have been serious in 1897, 1907, 1921. Their effects have been, however, relatively less than those of cyclones. Naturally, it is the marginal districts of the west that are most susceptible. These districts, too, have suffered most from the destruction of the forest, a destruction itself mainly carried out to extend the area under cane.

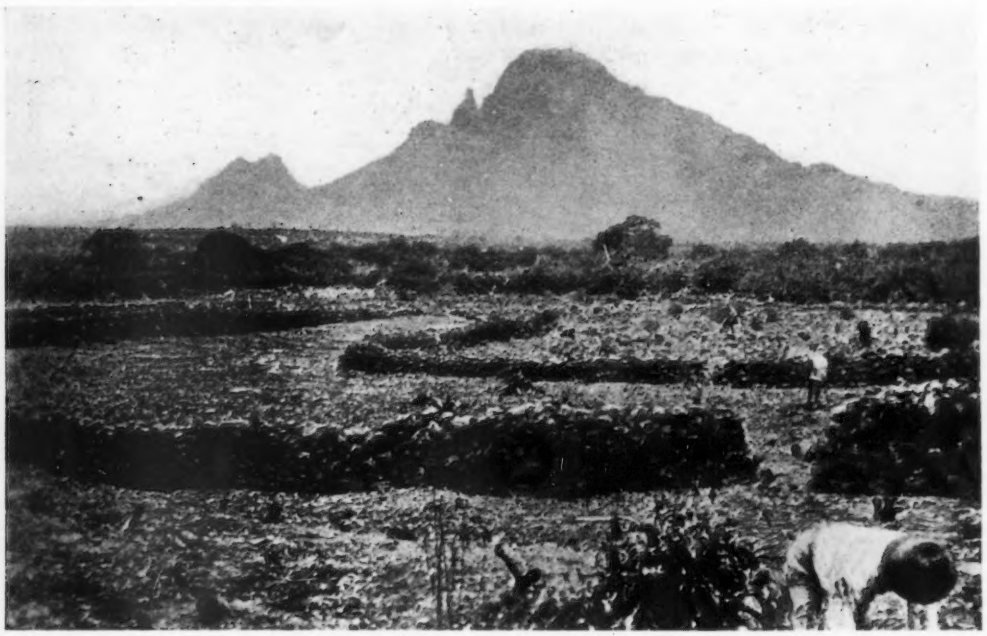


FIGURE 5.—In the drier north of Mauritius, the lava sheet has weathered into large boulders which are a serious hindrance to mechanical cultivation. The boulders are collected in long walls following the contours. (Courtesy of "Empire Production.")

SOILS

The sugar cane, though adaptable to a varied range of soils, thrives best in those that are not only fairly rich but well drained, while ease of working is a particularly desirable feature in countries where labour is scarce. In Mauritius, practically all the cane is grown on the Red Soils, which cover the greater part of the island save in the west and part of the north, where Black Soils occur. The Red Soils, as elsewhere in the Tropics, are the result of prolonged weathering, in conditions of great heat and moisture, of the parent rock, here a basic lava. These soils are fertile loams, of great moisture-retaining capacity, but at the same time open and very easily drained. Drainage is also greatly assisted over a large part of the Colony by the relief. They are easily cultivated even after heavy rain, which is also a matter of great importance for the sugar cane. Thus, their physical qualities as a whole make them particularly suitable for cane-growing.

In Mauritius the Red Soils are divided into three types:

(1) The Free Lands are those on which the most intensive cultivation is carried on, and they represent the Red Soil in its normal condition. They cover, roughly, a great part of the southeast (Grande Savane, and

parts of Grand Port and Flacq) and the open plains of the central district of Moka, an area where over half of the acreage and about two-thirds of all the production are found. The yields reach up to 40 to 60 tons, and even up to 70 tons per arpent. Savane, Moka, and Flacq are the districts in which the highest average yields of cane are obtained.

(2) In other parts of Flacq and in Pamplemousses the Gravelly Lands predominate. These also are very good, particularly as regards drainage. In fact, their rapid-drying qualities may become a danger in very dry years.

(3) Still more to the north the Rocky type is found. Here, in the comparatively dry part of the island, the lava sheet has weathered into large blocks. While the soil is consequently difficult to cultivate and presents a serious hindrance to implemental cultivation, the rocks have not entirely proved a drawback in that they help to prevent evaporation, a considerable advantage in the drier north, and also to maintain the temperature. As a result of the greater expense in cultivation, ratoonage is prolonged.

The Red Soils are rich in iron, in the form of oxide, very poor in lime and in potash, and extremely poor in phosphoric acid. Leaching takes place rapidly. Intensive cultivation soon led, therefore, to the need for fertilisers, and today the Mauritius cane lands are heavily fertilised, practically all the growers, including the Indians, being alive to the need for maintaining fertility at a high level. Although the lime-content is small the addition of lime is not as a rule necessary, very little lime being required by cane. The deficiency in phosphoric acid soon, however, became a limiting factor, and led as early as 1845 to the introduction of guano. This proved an important stimulus to production and the response, as seen in the subsequent rise in total production, was rapid. The

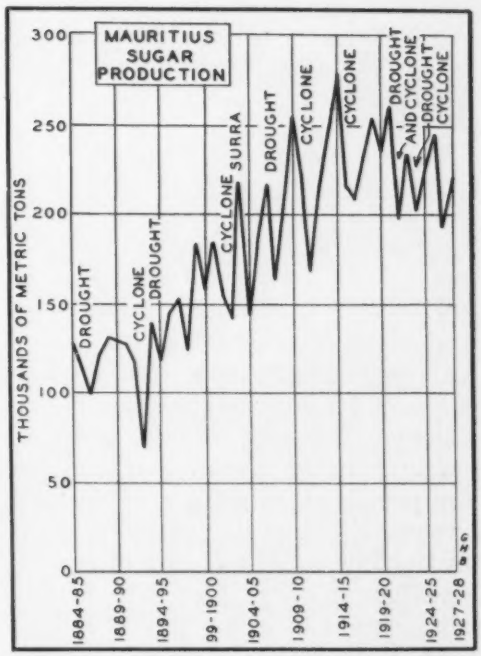


FIGURE 6.—Sugar production in Mauritius. (Data from Geerlig: "The World's Cane Sugar Industry," and Reports of Mauritius Dept. of Agric.)

nitrogen-content is very high, a very great advantage, and the soils are rich in nitrogen-fixing bacteria. The organic content of the soil has long been very carefully maintained, stable manure and factory waste being regularly applied with very beneficial results, while the use of molasses as manure, particularly for plant cane, has been practised since 1860 and has been a general characteristic since 1900. Not only does the molasses supply plant food, its potash content being particularly important, but it has a sterilising effect on harmful organisms and also improves the condition of the soil. The

FIGURE 7.—La Ferme Reservoir in the dry West of Mauritius is formed by diverting the surplus water of two streams and irrigates over 3,000 acres. (Courtesy of "Empire Production.")

practice of turning in legumes into the soil, as a means of maintaining the nitrogenous content, is also a well-established and characteristic feature of Mauritius cane agriculture, chiefly *Phaseolus lunatus* and *P. vulgaris* being used. The subsoils are peculiarly infertile and thus the average depth of cultivation is as low as 10 inches. The danger of turning up this infertile layer is a serious hindrance, and it has been suggested that the introduction of the disc plough may in this way have lowered the yields.

The Black Soils occur in the west and north, in districts where the annual precipitation is less than 50 inches. These compact soils present difficulties, apart from their coincidence with relatively arid conditions, which have been obstacles to the spread of cane cultivation.

CRITICAL IMPORTANCE OF THE LABOUR FACTOR

The climatic and soil conditions have favoured the predominance of the sugar industry but here, as in the British West Indies, its development has been possible only by the introduction of East Indian labour. The European population, in all only about 20,000, mainly of French descent, does not engage in manual labour, while the rest of the non-Indian population is for the most part engaged in general services of a non-agricultural nature. Since the abolition of slavery in 1834 and the final liberation of the negro slaves in 1839 the sugar industry has relied on India for its labour supply. The annual net immigration of Indians has throughout the century of its history shown large fluctuations. It reached its maximum in 1854, though the proportion of Indian immigrants in the total population did not reach its highest peak until 1861. Thereafter, the Indo-Mauritian population, that is, the Indians born in Mauritius, gained. The increased restrictions of the Labour Law of 1867 marked the end of the period of greatest influx. In that year, for the first time since the beginning of Government regulation of immigration in 1842, there was a net emigration, and since then there have been only minor fluctuations to either side of the migration balance. In 1910 assisted immigration was discontinued, the direction of the Colonial Office, after the Royal Commission of 1909 having declared its opinion that the Indian population of the Colony was sufficient, if all were employed. Eleven years later, according to the 1921 Census, the Indian population numbered 264,537, or 71 per cent of the total population. There had been a falling-off not only in the quantity but in the quality of the immigrants, and this was coincident with increasing prejudice in India against emigration to the Colony and indentured emigration in general.

The labour problem originates, however, from causes operating

FIGURE 8.—East Indian labour in Mauritius. Cane cutting—the men cut the cane, the women and children strip off the leaves. (Courtesy of Miss M. I. Freeland.)

within the Colony. In the first place the normal growth of an immigrant population has led to a decrease in the proportion of the effective labour-force to the whole, since the proportion of males to females has decreased, and there being also a greater proportion of old people. Amongst economic causes the chief is the progress of "morcellement," the breaking-up of the estates into small holdings, which results in a scarcity of hired labour on the remaining estates. The rapid extension of this process began after 1910, under the stimulus of low prices, many of the estates selling land to former labourers on easy terms, usually on condition that the land remains under cane. In this way the proportion of cane land held by Indians increased from 30.3 per cent in 1909 to 43.1 per cent in 1917, and then more slowly to 46.2 per cent in 1922. Much of the increase in cane area in the post-war boom years took place on Indian lands. Morcellement proceeded most rapidly on the relatively inferior lands of the drier north and in those parts of Grand Port and Savane where transport conditions are less satisfactory. Co-operative credit societies have assisted and stabilised the process, especially in these more difficult areas. The Indian population living on the sugar estates has been declining rapidly, and at the end of 1925 only 25 per cent was on the estates. The number of able-bodied Indian males between the ages of 20 and 49, who are essential for the heavy work on the estates, has been declining still more rapidly. The scarcity of labour was accentuated in the post-war boom years, when on the one hand the estates were anxious to get more labour to extend cultivation while prices were high, and on the other hand the high prices for cane enabled many of the small Indian planters who had formerly eked out their living by hiring themselves out as labourers to cease doing so. Many Indian women, too, who had for merly worked in the fields, now stayed at home, while the higher wages enabled those men who still worked on the estates to work fewer days. The after effects of the terri-

ble influenza epidemic of 1919 were then felt, too, with great weight. Further negotiations with the Indian Government on the migration question were stimulated during those years, but without satisfactory agreement.

The proportion of the Indian population engaged in agriculture generally has been declining, too, from its maximum in 1881 at an increasing rate in each successive decade. There has been a drain of the agricultural population in the chief town, Port Louis. The Mauritius Government's own vigorous public works policy has itself increased the possibilities of non-agricultural employment, thus accentuating the difficulty.

Since the areal limits of sugar production have been reached, the operation of labour shortage as a limiting factor is felt because of the difficulty of intensifying cultivation and raising yields. It is, however, difficult to separate the effects of labour shortage in this respect from those of the progressive "morcellement" and corresponding increase in the area of operation of the relatively inefficient small planters. Total production in the staple industry has continued to increase at a rate sufficient to cause quantitative production per head of population to also increase, but in both cases there has been in recent years a slowing-down. As demand for labour has continued during this period, it is evident that the product can still find a market, so that the optimum population has not fallen. It cannot, however, be said that the actual population is below what would be the optimum, assuming that it were working at normal efficiency. The temporary decline in efficiency due to the increase of peasant proprietorship may be adequate to explain the tendency of the rate of increase of production to decline. If this is so, the introduction of fresh immigrant labour, even were it available, would be inadvisable especially in view of the industry having reached its areal limits. The solution of the difficulty will eventually come by increased output per head as efficiency increases.

The labour problem is being partly met in Mauritius, as elsewhere, by the increased use of agricultural machinery on the estates. The use of the tractor has extended rapidly in the last few years under the stimulus of rising costs, until by the end of 1926 there were 117 in use.[5] Hindrances to this development are that the tractors are not yet adapted by the makers to Mauritius conditions, a drawback that will doubtless be removed as the market grows; the deficiency of skilled labour essential for the further mechanisation of agriculture; the small size of the fields and rocky nature of much of the surface in the north; and the extension of peasant proprietorship which enhances the obstacle of initial cost. On the other hand, the tractor permits more rapid work and can use the power alcohol which is a potential by-product of the molasses. Plough-driven furrows are replacing the old hand-dug cane-holes, and subsoiling ploughs are in use for after-cultivation. P. de Sornay quotes figures[6] which show that the use of the plough reduces labour costs by 42 per cent in the case of plant cane and by 36 per cent in ratoons.

A more gradual but far-reaching line of attack on the labour problem

[5] Mauritius Dept. of Agric. Ann. Rept. for 1926.

[6] P. de Sornay, *La Canne à Sucre à l'Ile Maurice*, 1920, p. 642.

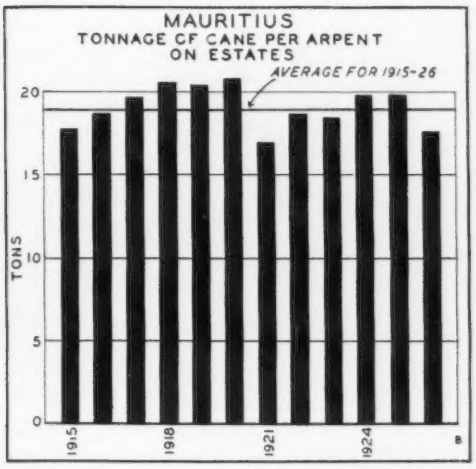


FIGURE 9.—Tonnage of cane per arpent on estates in Mauritius.

is in the direction of improved public health. The density of population—538.5 to the square mile in 1924—makes sanitation a difficult problem. As in most other parts of the Tropics, the diseases that have the most deleterious effect on the economic life of the community are malaria and hookworm. Dr. A. Balfour, in his report of 1921,[7] stated that "despite the many natural advantages of the Colony, its general unhealthiness had reached a degree unparalleled in any similar tropical Dependency of the Empire." He concluded that the chief weapon in the difficult task of rendering the island healthy would be education. The malaria problem is rendered difficult by the fact that at least three species of Anopheles mosquito, with different habits, act as vectors. Favourable breeding places are abundant on the sugar estates. The Government has initiated an energetic campaign against the mosquitoes. With the other scourge, hookworm, examinations hitherto made indicate that about three-quarters of the population is infected, the proportion of infection on the sugar estates, and especially on those of the more humid districts, is probably much higher. Largely due to the campaign initiated by the Rockefeller Foundation, treatment is being widely adopted, and experience elsewhere in the Tropics has shown that the effects of such measures on efficiency are immense.

[7] Balfour, A. Rept. p. 1.

DEVELOPMENT OF PRODUCTION

The total production of sugar in Mauritius showed an upward trend from the eighties to 1914, when the maximum thus far of 277,400 metric tons was reached; since then the trend has been downward. The area under cane rose to 172,000 arpents in 1921, under the influence of high prices; in that year, however, drought reduced the crop seriously. The downward trend in area since has been at a rather more rapid rate than the rise in the corresponding previous period. Since most of the best land was already under cultivation, the rise in area to 1921 occurred mainly on inferior lands, chiefly in the north, where the soil is poor and the climate dry. In the Black River district a very considerable increase took place on the irrigated lands of La Ferme. It was almost entirely virgin land that was brought under cultivation at this time. As so much of this was of definitely inferior type average yields fell in these years. The downward trend since has represented merely the abandonment of these lands when prices no longer made it possible to cultivate them economically. The total of possible permanent expansion of the cane area—in the irrigated districts—is small and unlikely to raise permanently the total cane area much beyond the 1921 maximum.

The other line of possible increase

in total production is by raising the yield per unit area. While there has been a rise in the standard of cultivation on the estates, this has been neutralised by the steady decrease in the area cultivated by them. Although the Indian planters are not unprogressive the small scale of their operations, lack of capital, personal inefficiency, all operate to cause their standards to lag behind. A serious feature in the situation is the diminution in the sugar-content of the canes; Mauritius is steadily losing its superiority over Java in this respect. This diminution has proceeded at a rate sufficient to counterbalance the increased efficiency of the factories in the extraction of sugar.

Mauritius has come to be dangerously dependent on one variety of cane—White Tanna—which by 1925 had spread over 58 per cent of the total cane area. Its popularity is due to its disease-resisting powers and to its being equally adapted to both upland and lowland districts. In spite of this considerable reliance on one variety of cane and to the long-continued and little-interrupted occupation of the soil by cane, the Colony has, however, been fortunate in its freedom from serious cane diseases. The most serious pest is the cane-borer (*Phytalus Smithi*).

Under the influence of increasing competition from Europe and from other tropical sugar producers, the manufacture of sugar has, since 1863, been steadily concentrated on a diminishing number of factories. Here as elsewhere, too, the business of cultivating the cane is being steadily separated from that of manufacturing the sugar. The proportion of the cane area cultivated by the factories decreased from 46 per cent in 1911 to 31 per cent in 1925. Despite

FIGURE 10.—Older method of transporting cane to factory by bullock cart in Mauritius. The small growers still send much of their cane by road. (Courtesy of Imperial Institute, London.)

the great decrease in number of factories that has occurred, the concentration of production has lagged behind the necessities of the country. The size of factories in Mauritius is still very small in comparison with that in the chief sugar-producing countries. Centralisation of the production of sugar for each district on one factory, which is the modern road to economic production, demands more capital than is readily available in the Colony, where the European population clings to the Catholic tradition of large families and the French tradition of equal inheritance. Costs of production are relatively high as compared with those of the great producers of raw sugars. Even the best Mauritius factories do not attain the average efficiency in the extraction and recovery of sugar of Java and Hawaii, and competition between the relatively numerous factories for cane raises the price of their raw material.

INFLUENCE OF THE MARKET

The wider aspects of competition in the world market are bringing

about a change in the products of the industry. Before the War India was the chief market for Mauritius sugars, generally taking over 60 per cent of the production. The remainder was divided between the United Kingdom, which was taking a gradually increasing proportion even then, South Africa, Australia, and Hong-Kong. With respect to the Indian market the island had the advantage of comparative proximity and relatively easily available freight facilities, most of the inward freights being from that country. So long as this market was dominant raw sugars of about 96° polarisation remained the chief product. During the War and in the years following, the bulk purchases of the British Royal Commission on the Sugar Supply diverted practically the entire crop to the United Kingdom. Since then, save in 1924, the Indian market has never regained its former preëminence and Great Britain has absorbed almost the entire output, Australia and South Africa having meanwhile become self-supporting and protected their home production by means of embargo and high tariff respectively. With this change in the situation, the Mauritius manufacturer has been encouraged to increase his production of direct-consumption white sugar of about 99.5° polarisation to suit the higher tastes of the British market, and so enters into competition with the British refiners, who formerly worked up the whole of that portion of the Mauritius export reaching the British market. These direct consumption sugars are produced by the sulphitation process, in which Mauritius was a pioneer. Great Britain now occupies a position of even greater predominance as a market for the Colony's sugar than even India ever did, and this position has been greatly strengthened by the British preferential tariff. The crop comes on the British market principally from October to March, and during November to January, when the Cuban supply is at a minimum, Mauritius has, as in recent years, been the chief source of supply for this country.

FIGURE 11.—Transport of cane to factory by plantation railway in Mauritius. (Courtesy of Imperial Institute, London.)

Since the War the export of the chief by-products of the sugar industry, rum and molasses, has been in-

significant. Both exports formerly reached high levels, but tariffs and freight difficulties have destroyed their markets. A new possibility has, however, arisen that is of great consequence to the industry, the utilisation of the molasses for the manufacture of power alcohol.

POSITION OF MAURITIUS AS A ONE-CROP COUNTRY

The excessive dependence on one crop, with all the risks of climatic vagaries and disease pertaining thereto, has led to some disquietude. The possibilities, not only of disaster to the crop, but of increased difficulty in marketing the product, are a grave danger to a country depending almost entirely on an imported food supply. The tendency to downward movement in the trade balance of the Colony since 1914 points the moral. The large Indian population has with the stimulus of high prices turned its attention to the money crop and not to food crops, and the result has been a growing import of rice, grain, pulse, and flour. The other chief imports are cottons, artificial fertilisers, machinery, coal, and coke. The position of the sugar industry makes an increasing import of artificial fertilisers and of new machinery a necessity of the future. Exports other than sugar are at present insignificant. The export of the most notable secondary product, aloes fibre, has fallen greatly since the War and experiences great fluctuations, and similar misfortunes have been experienced by the other minor products, such as vanilla, coconut oil, copra, and manioc. The internal market is too limited to give the initial stimulus to a new money crop, while foreign markets suffer from the disadvantage of distance, accentuated by the freight difficulties already experienced, or of having more easily available of highly protected supplies of the various commodities. Capital is scarce enough for the urgent demands of the sugar industry, which must always remain at any rate the chief one, and the amount of capital already invested in the staple industry makes the need for maintaining its capacity, and therefore the area under cane, insistent. The extensive practice of ratoonage makes it difficult to reduce

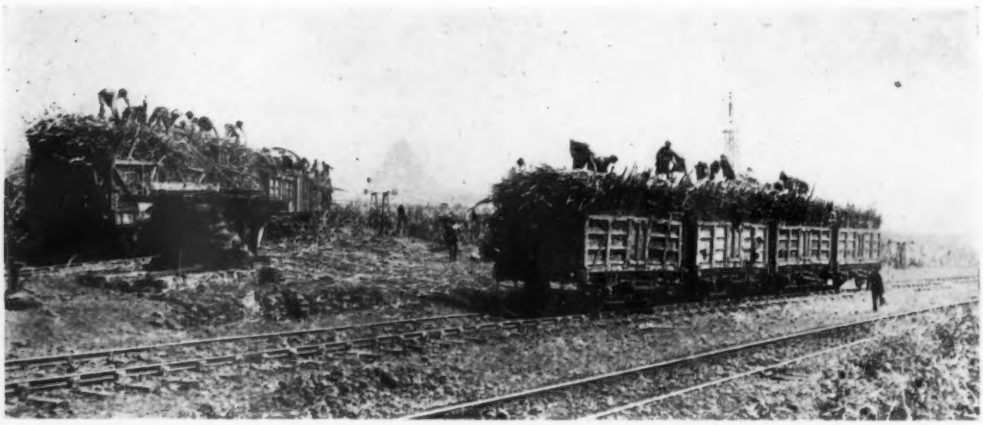


FIGURE 12.—Transport facilities are satisfactory in Mauritius. Loading the cane on railway trucks for transport to the factory. (Courtesy of Miss M. I. Freeland.)

the area under cane, and added to these difficulties is the great problem of labour supply, which, strongly as it is felt in the established industry of the island, would be even more felt in attempting to extend the activities of another industry. As for food crops, the growing of various "ground provisions" such as sweet potatoes is strongly advocated by the Department of Agriculture.

Mauritius conspicuously illustrates the economics of a small one-crop country. Climatic and soil conditions are very favourable to sugar cane and almost the entire area suitable for its cultivation has been occupied by this crop, in some recent years only one-fifth of the total cultivated area being otherwise utilised. Having once embarked on its career of dependence on a dominant money-crop, the Colony finds itself by its location, its financial position, the circumstances of the world's markets, and the economic necessities of the sugar industry itself, forced to persist in this course. In no other country can it be said with more truth that "Sugar is King." In face of this situation, with its accompanying dangers, there is an urgent necessity to stabilise the industry by resolute measures in order to maintain and raise the level of its productive efficiency. The labour shortage by compelling the increased use of mechanical and other methods of raising output per head, has already set the industry in the right direction for progress. While further immigration might alleviate certain difficulties of the present, it would probably aggravate the difficulties of the future, which can be solved only by bringing about more economic production per head. In the long run, therefore, the relatively low rate of increase in the population is for the Colony's good. In Mauritius, as in other parts of the Tropics, the immense importance of bold public health measures in raising general standards is gradually being realised, and the developments that have been initiated in this direction, though slower in effect, promise well for the future. While irrigation schemes and some few necessary improvements in transport facilities will make possible some comparatively slight expansion of the area under cane, the main efforts of the community must be directed to lowering costs of production. The process of "morcellement" that has rapidly extended has certainly added very greatly to the difficulties in the way of improvement, but some recent developments offer hopes of their reduction, and the process contains elements not only of weakness but of strength. Progress towards lowering unit costs demands, besides the overcoming of the usual forces of conservatism, the initial expenditure of a considerable amount of capital. However, the financial position of the Colony has been good so far and, while it is yet possible, the good returns of the past can be made the basis of future development.

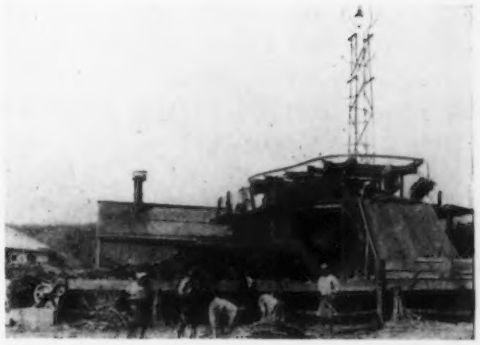


FIGURE 13.—Cane arriving at factory by aerial ropeway in Mauritius. The hilly nature of much of the Mauritius cane land makes this method of transport necessary. (Courtesy of Miss M. I. Freeland.)

AGRICULTURE AND COMMERCE OF UGANDA

Earl C. Case

Geographer, University of Cincinnati

THE Protectorate of Uganda, which occupies 110,000 square miles in the heart of Africa, lies astride the equator (Fig. 1). Despite this fact, its great range of elevation gives it a diversity of climates which vary from near desert to that of exceedingly heavy rainfall, and from the hot debilitating temperatures of the lowlands to perpetual snow and ice on the mountainous uplands. The first reports of perennial snow near the equator seemed so anomalous that the geographers at home believed they were merely the fanciful stories of travelers. Except in the Rowenzori Mountains of the southwest where it is cool, and in the lowlands of the north where it is hot, the temperature is moderate and varies but little throughout the year. Most of the populous areas of Uganda lie at altitudes of 3,000 to 5,000 feet, and although the climate is much more pleasant than in the lowlands, it cannot be considered healthful for Europeans.[1]

The rainfall varies greatly from one section to another (Fig. 2), and as in most equatorial regions is unreliable at best. In the southern part of the Protectorate there are four seasons—two wet and two relatively dry; towards the north, the type of climate changes to summer rains and winter droughts (Fig. 3).

The isolated position of Uganda delayed commercial development of the area until the beginning of the present century, and made it one of the last portions of Africa to feel the beneficial influence of western civilization. Prior to 1900, the only commercial products of this equatorial upland were slaves and ivory, secured, for the most part, by the unscrupulous traders who planted the seeds of suspicion and hatred in the hearts of the natives, and made the problems of true development difficult.

In spite of the handicaps of location, climate, and unpleasant contacts with the early traders, the development of Uganda during the past twenty-five years has gone forward with remarkable rapidity. Natives, who are not yet old, remember when human beings were bartered among man-eating tribes.[2] They have seen slaves captured and sold for a few trinkets to Arab traders who loaded them with ivory and marched them on a dismal journey to the coast, where both they and their cargo were sold at neighboring markets. Today all this is changed: both life and property are relatively secure; the wealth of the natives is increasing rapidly through the export of cotton and other agricultural products, which are worth many times the value of the slaves and ivory of a generation ago. The early imports of beads, trinkets, and a little calico, have been displaced by motor-cars, bicycles, plows, hoes, shovels, millions of yards of cloth,

[1] Wallis, R. H., *Hand Book of Uganda*, 1920.

[2] Nordmen, Herman, *White and Black in East Africa*. H. F. & G. Witherby, London, 1924.

and other products useful in the development of a country. Next to Zanzibar and the Gold Coast, Uganda now leads the continent in the per capita value of export trade.

in food and cattle that it was regarded as the "promised land" by caravans from the east coast. Eastern Teso supported an "enormous density of population" before west-

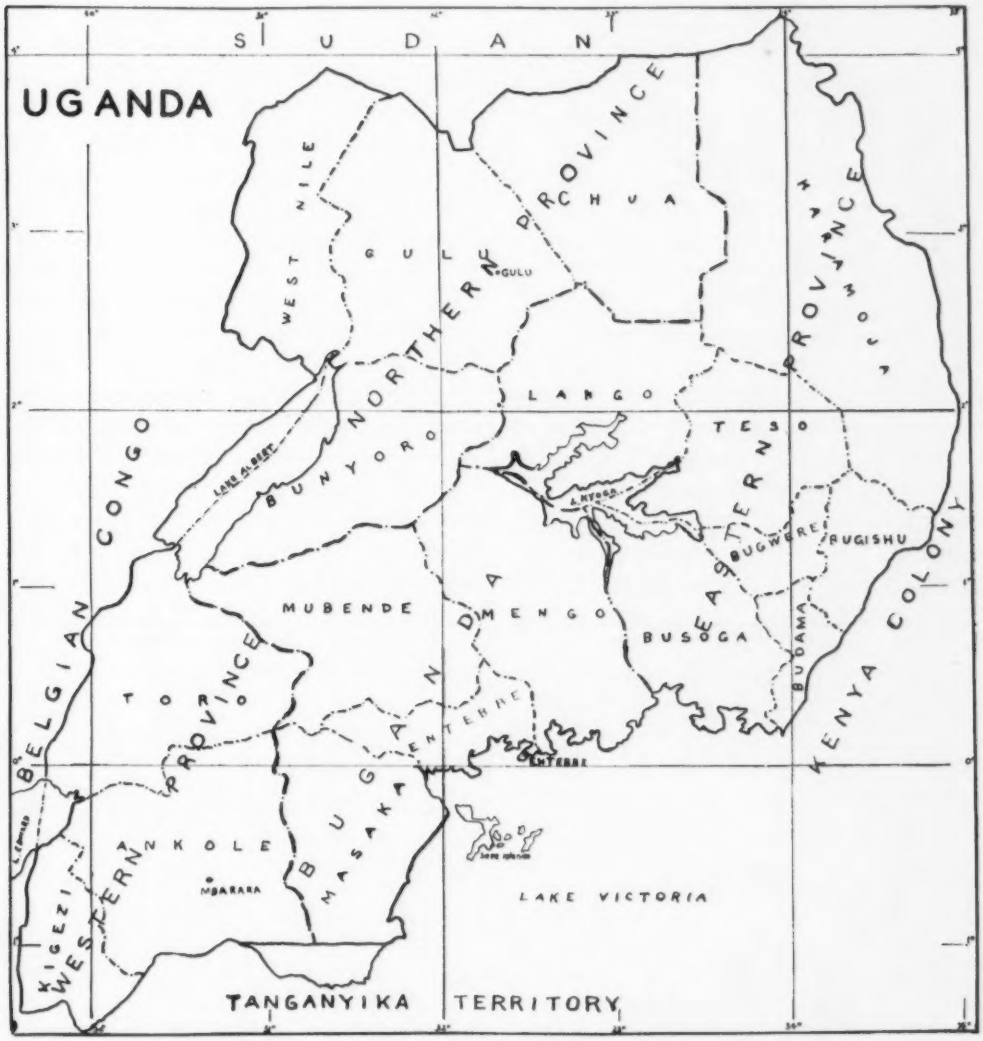


FIGURE 1.—Place map of Uganda.

EARLY DEVELOPMENT OF SUBSISTENCE FARMING

Agriculture was already well developed within the present bounds of Uganda when the early European explorers arrived. The southern part of Busoga was so singularly rich

ern ideas had influenced the region. The lower slopes of Mt. Elgon, and mountain spurs stretching far out into the surrounding plains, were continuous fields of bananas, millet, and wimbi. More than 80 per cent of the land in extensive areas was

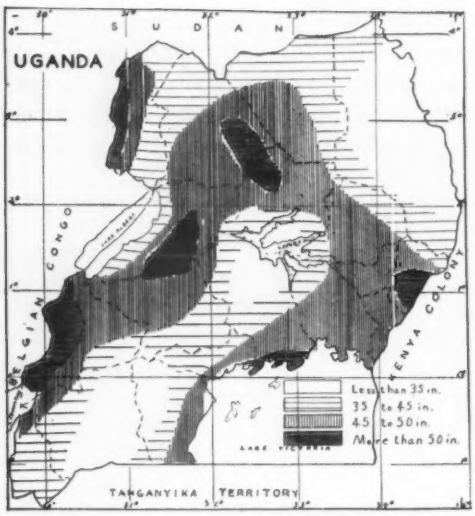


FIGURE 2.—Rainfall map of Uganda.

under cultivation, and only a few green patches of grass had been spared to provide pasture for cattle and goats. The boundaries of all the plots were so clearly and neatly marked that the country side reminded one of the vineyards of Switzerland and southern France.[3]

Agriculture was the chief occupation of all tribes except those living within the more arid areas of the southwest and the northeast (Fig. 2), where pastoral activities were dominant.

Not all of Uganda, however, was densely populated. There were large areas of fertile land lying waste then just as there are today—probably the result of pestilence and famine. For example, the Sese Islands in Northern Lake Victoria were once the habitation of hundreds of thousands of people. Today they are dense jungles. Sleeping sickness wrought such devastation among the islanders in 1907 that there was a wholesale removal of those who survived to the mainland. Attempts to repopulate Sese have been made, but the people are unwilling to return to their old homes. Large sections of southern Busoga, which were at one time densely populated, are now waste.

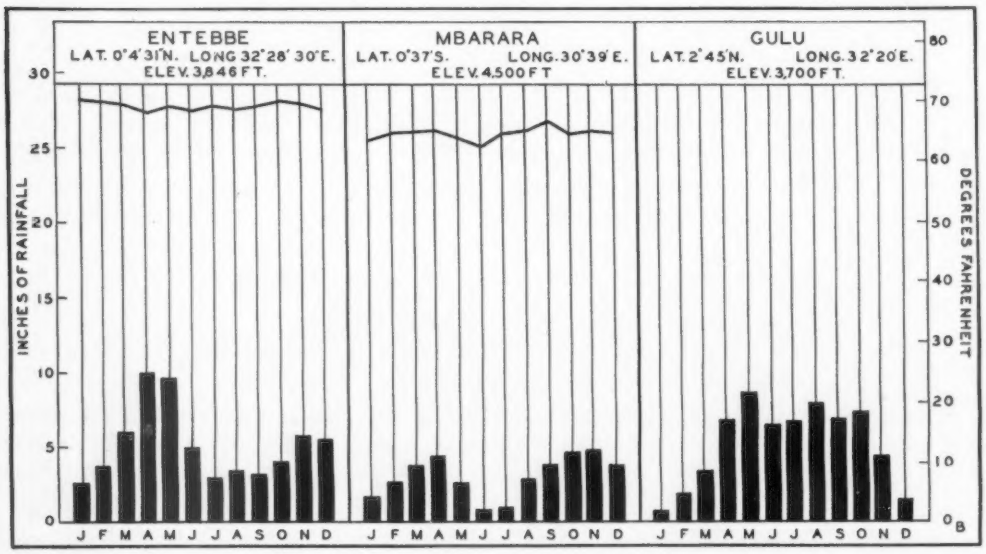

ENTEBBE
LAT. 0°4'31"N. LONG 32°28' 30"E.
ELEV. 3,846 FT.
MBARARA
LAT. 0°37'S. LONG. 30°39'E.
ELEV. 4,500 FT
GULU
LAT. 2°45'N. LONG. 32°20'E.
ELEV. 3,700 FT.
INCHES OF RAINFALL
DEGREES FAHRENHEIT
0 5 10 15 20 25 30
0 10 20 30 40 50 60 70 80
J F M A M J J A S O N D

FIGURE 3.—Comparison of monthly distribution of rainfall and temperature at three Uganda stations.

Sleeping sickness first spread through the district; later, in 1900, a terrible outbreak of smallpox carried off

[3] A Tour Through the Eastern Province of Uganda, Colonial Report, No. 57, p. 11.

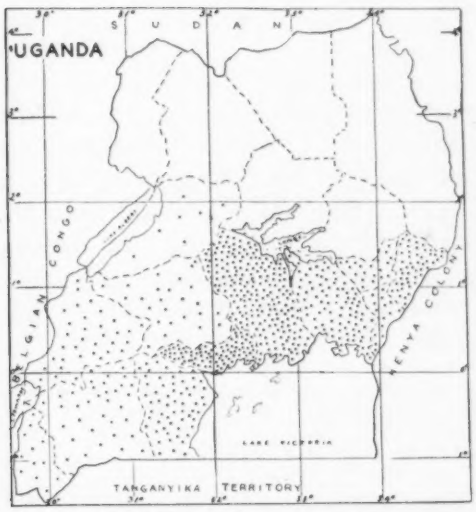


FIGURE 4.—Distribution of plantain culture. Each dot represents 1,000 acres. The dots are uniformly distributed throughout the districts, but relatively little is grown in areas of less than 35 inches of rainfall (see Figure 2).

many thousands; the famine of 1908 completed the devastation so that now the land is bush, inhabited by pigs, leopards, hyenas, and other wild animals.

PRESENT TYPES OF SUBSISTENCE AGRICULTURE

The agriculture of Uganda is rather sharply divided into two types—plantain growing in the southeast and millet production in the north and the extreme southwest (Figs. 4 and 5). In addition, there are two areas—one in the northeast and the other in the southwest—where, because of light and uncertain rainfall, pastoral activities are still important, if not dominant.

Each type of agriculture has its own division of labor. Where plantain is the chief food, agriculture is the work of women. The increasing need for laborers to work in the cotton fields, together with the influence of western ideas, have resulted in more of the work being done by the men. The men help clear the land after which their labors are relatively light.[4] In the millet-growing area men till the soil and harvest the crops, assisted more or less by the women and children; in the pastoral districts, on the other hand, women have little to do. Men care for the cattle and, since the natives wear but scant clothing and live almost exclusively on a milk diet which requires no special preparation, the amount of housework is negligible. As a result, the women have an easy time.

The Plantain Belt

Plantain is the most important subsistence crop of Uganda and ranks second only to millet in the acreage cultivated (Fig. 6). Al-

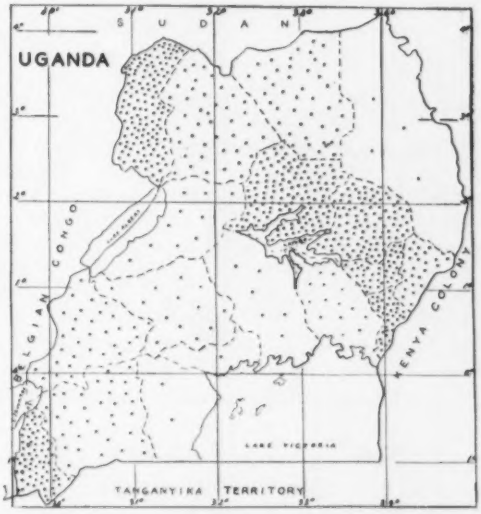


FIGURE 5.—Distribution of millet culture. Each dot represents 1,000 acres.

though a slightly larger acreage is given to millet, the plantain is more productive and yields during the entire year. Within the southeastern part of the Protectorate it is the chief food-crop of the natives, and in

[4] Roscoe, John, *The Burganda, Their Customs and Beliefs*, p. 430.

several districts it occupies more than twice as much land as all other food-crops combined. Its dominance was even greater a few years ago when, over extensive areas, it occupied more than 85 per cent of the land cultivated in food-crops.[5] Earlier reports indicate that in certain sections it was grown to the exclusion of all other crops and that thousands of natives were obliged to

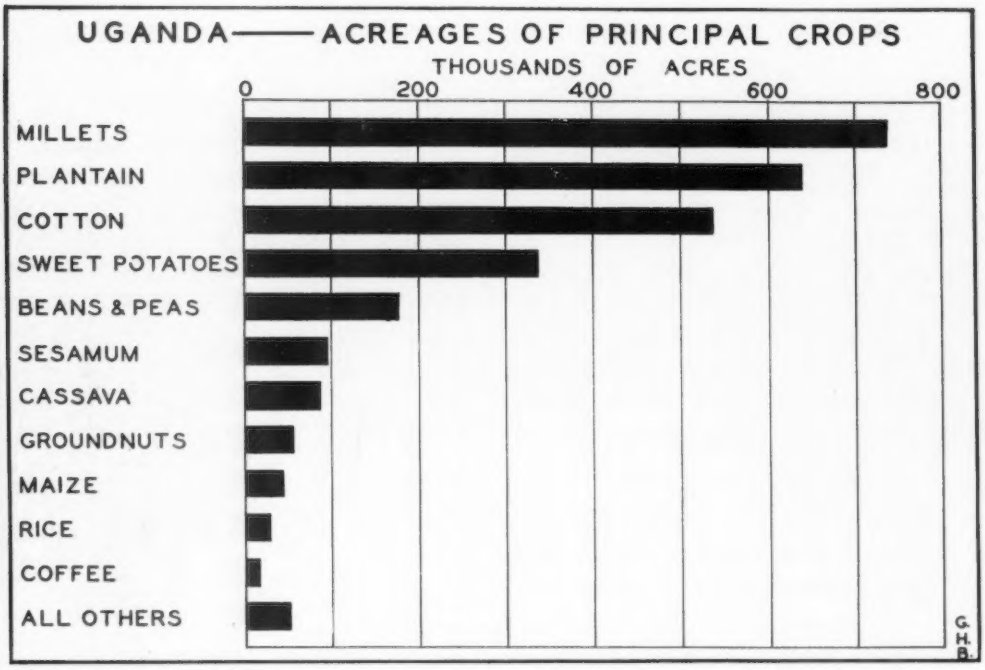


FIGURE 6.—The acreage given to each of the principal crops of Uganda (000 omitted).

eat nothing but plantain pulp.

During the last few years the cultivation of sweet potatoes, cassava, sesamum, beans, and groundnuts has increased rapidly, but the natives still look to the plantain as the mainstay (Fig. 7).

Where the plantain tree bears well, it affords a reliable food supply throughout the year with the minimum amount of labor. After the land is cleared and the plants are started, they continue to yield fruit year after year. When once a tree begins to grow, it soon makes side-shoots which are well developed by the time the fruit of the parent tree is ripe. Thus, until the soil becomes depleted, the food and beer supply of the family is assured, unless the rains fail or the locusts destroy the crop. During the dry season no care is given to the plantain garden except that of merely cutting the fruit; when the rains come, the weeds must be kept down in order that the crops may thrive.

Since the plantain tree yields during the entire year, the natives make no provision for the future, unless it be to dry a little fruit. As a result, any failure of the crop brings on famine. When the dry season lasts longer than two months, the plantain yield decreases. Fortunately, the

[5] Uganda Protectorate, Ann. Report, Dep't of Agr., Entebbe, 1920, p. 42.

roots of the tree, which contain some nourishment, may be eaten by the natives to help tide them over such periods. Yet malnutrition and starvation, combined with pestilence, has practically depopulated large areas from time to time.

The Cereal Belt

The natives of northern Uganda are even more dependent upon cereals than those of the southeastern part are upon plantain. In Gulu and Chau, millet and sesamum (primarily millet) occupy 96 per cent of the land cultivated in food-crops. In the other districts, sweet potatoes, cassava, beans, and peas are more widely grown, but north of Lake Kyoga, cereals constitute the main food-crops, just as the plantain does in the southeast.

This contrast in agricultural types is usually ascribed to the fact that northern Uganda is populated with grain-eating peoples—the Neolithic groups—whereas, southern Uganda is occupied by plantain-eating peoples—the Bantu groups. The agricultural difference, however, is undoubtedly more closely related to environmental contrasts than to racial prejudices or appetites. In the north, the seasons are quite distinct and the dry period may last for several months, even where the average annual rainfall is heavy. For example, the average precipitation at Gulu is more than 50 inches; yet, in 1924, the rainfall during the five months, November to March inclusive, was only 4.49 inches,[6] resulting in a drought which would have been fatal to plantain trees.

The rainfall of this northern section is also extremely local, and any

FIGURE 7.—A typical native shamba surrounded by plantain, peas, and sweet potatoes—the three principal food crops of southern Uganda. (Courtesy of L. W. Kephart, Foreign Crops Division, U. S. Dept. of Agric.)

[6] Uganda Protectorate, Ann. Report, Dep't of Agr. 1924, p. 52.

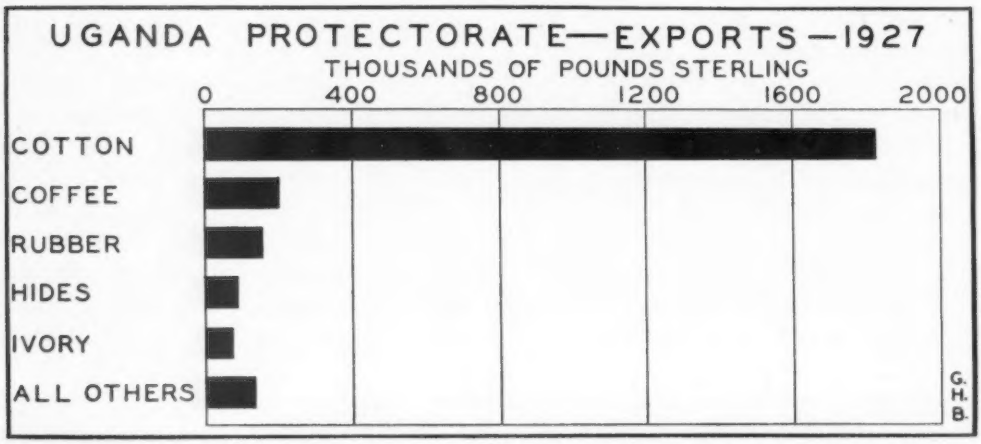


FIGURE 8.—Exports of Uganda Protectorate, 1927, pounds sterling (000 omitted). (Compiled from Uganda Dept. of Agric., Entebbe, 1928, page 51.)

given plot of ground may be missed by showers for months at a time. This fact is so well recognized that it is the custom of the natives to plant their crops in little plots widely scattered, in order that if some plots suffer from drought others may be more fortunate. In places sandy soil adds to the droughty character of the *cereal belt*, making it suitable only for those crops which mature quickly.

Although the northern section is poorly suited to plantain, it produces good crops of millet when the season is favorable. Failures, however, are frequent and during years of abundance large reserves of grain are stored for years of dearth. Yet, the problem of keeping the grain for any protracted period of time in this hot climate is not a simple one. Millet seed, which can be kept almost indefinitely in our own semi-arid

FIGURE 9.—A cotton ginnery and a field of cotton interplanted with plantain. Most of the cotton is grown in quarter-acre or half-acre plots. (Courtesy of L. W. Kephart, Foreign Crops Division, U. S. Dept. of Agric.)

West, is soon attacked in Uganda by beetles and weevils, making it difficult to save even with our modern knowledge of science.

The Pastoral Belt

There are two large districts in Uganda—Ankole and Karamoja—where the rainfall is light and unreliable, and as a result, they are primarily given to pastoral industries. In Ankole the governing class is composed of a people who are entirely pastoral and look upon agriculture with contempt. Many of these cowmen live entirely on a milk diet and it is of interest to know that during the war they were tested in the carrier corps and found to be capable of hard and sustained work.

In the pastoral areas, cows are the highest form of currency and all prices are regulated by their value. Wives are purchased by the payment of one or more cows, and the value of sheep and goats is fixed by the number a man will exchange for a cow.

The lower classes cultivate fields of millet and bananas, which they use as food and for the manufacture of beer, both for themselves and the upper classes.

COMMERCIAL CROPS

The construction of the Uganda Railway afforded opportunity for developments within the Protectorate which have been almost revolutionary in proportions. Formerly, the tribes were primarily subsistence farmers, consuming all they produced. As previously stated, the only exports were slaves and ivory for which the natives received little of value in return. The completion of the railway from Uganda to the coast in 1901 encouraged the promotion of other commercial enterprises. The rapidity with which

FIGURE 10.—Elephant grass—one of the most common types of native vegetation. It is no easy task to clear this ground and prepare it for planting. (Courtesy of L. W. Kephart, Foreign Crops Division, U. S. Dept. of Agric.)

this development has taken place is indicated by the fact that the exports increased from practically nil in 1905 to more than 25 million dollars twenty years later. More significant, however, than the development of this export trade has been the far-reaching changes which it has brought about in the economic and social status of the natives.

COTTON, THE MAJOR COMMERCIAL CROP

Cotton has grown wild in Uganda for centuries, but apparently the natives had no idea of its potential value until its cultivation was introduced by European missionaries in 1900.[7] Since then the production has increased with such remarkable rapidity that 20 per cent of the cultivated land is now given to this crop. During the last few years cotton has become of such great economic importance that it has been called "the life blood of Uganda," and at present represents more than 90 per cent of the total exports of the Protectorate (Fig. 8).

The crop is grown entirely on native plantations and by native labor. Its cultivation has spread to every district except Karamoja, in the northeast, where the rainfall is too light or uncertain for cotton culture, and West Nile, Kigizi, and Toro, all poorly situated with respect to improved transportation facilities. Moreover, much of West Nile and Toro are low, swampy, hot, and unhealthful.

The usual method of cultivation is to clear about a quarter-acre of grass, weeds, and trees after which the land is merely dug over lightly with a hoe. There are no large plantations of cotton in Uganda. Most of it is grown in quarter-acre or half-acre plots, and frequently is interplanted with other crops (Fig. 9). Plowing schools have been introduced, but less than three thousand plows were in use in 1927.[8] Several difficulties have prevented a rapid increase in the use of machinery: soil choked with the roots of elephant grass and papyrus, two of the most common types of native vegetation, is difficult to turn with a plow (Figs. 10 and 11); rinderpest has preyed upon the oxen, making many of them unfit for work; and plows are bought by communities or chiefs, as individual farmers do not cultivate fields large enough to encourage the purchase of such expensive machinery.

In a few places tractors have been used in breaking large tracts of land, which are then subdivided into half-acre plots and let out to the natives for planting and cultivating. Most of the work, however, is still done with the hoe, matchet, ax, and spade. In 1926 and 1927, slightly less than a million of these simple tools were imported—almost enough to supply every able-bodied laborer in the Protectorate.[9]

The amount of human effort required to produce and market cotton in Uganda would be considered appalling in the American Cotton Belt. After the native has cleared the land with an ax and matchet, and has broken the ground and cultivated the crop with spade and hoe, he must then carry his crop on his head to the ginnery, often many miles away. Human portage is still the common

[7] Report on the Introduction and Establishment of the Cotton Industry in the Uganda Protectorate, Colonial Report No. 62, 1909.

[8] Uganda Protectorate, Ann. Report, Dep't of Agr. 1927, p. 16.

[9] Annual Trade Report of Kenya and Uganda, Nairobi, 1928, p. 30.

FIGURE 11.—Papyrus—one of the most common types of native vegetation found in the poorly drained areas. (Courtesy of L. W. Kephart, Foreign Crops Division, U. S. Dept. of Agric.)

method of conveying the seed-cotton to the ginneries, although during the last few years, light trucks are being introduced for this purpose.

After the cotton passes into the hands of the merchants, much of the work is done by efficient machinery; modern ginneries separate the lent from the seed, and trucks made in Europe and America transport the fiber to railroad points and to lake ports for shipment to the textile mills of industrial countries.

Cotton Culture and Social Conditions

Costly as this cotton seems, in human effort, its cultivation has brought about changes in social conditions which are little less than revolutionary in character. As a result of its production, both peasants and landlords have become comparatively wealthy. While the standards of living are still extremely low, compared with those of European peoples, they are incomparably better than they were a few decades ago, when because of famine, pestilence, tribal wars, and slave raids, neither life nor property were secure.

The old round-thatched hut with but an aperture for a door, is giving way to a square house with windows, doors, and chimneys (Fig. 12). Many of these homes are surrounded by gardens, lawns, and reed fences. European cooking utensils and knives and forks are being introduced, while European crockery is displacing the old native calabash. Nudity is disappearing and the sale of cloth to the natives is tremendous. In 1927, more than 16 million yards of cotton goods and 50,000 dollars' worth of silks were imported.[10] The sale of boots and shoes, underwear, women's dresses, and umbrellas, while not large, is increasing.

In 1900, there were no roads in Uganda, and the natives had little or no freedom in moving about. Today the Protectorate has thousands of miles of good highways which reach into almost every district, and the natives move about freely, going to the most remote part of the Protectorate to find employment. They have purchased 10,000 bicycles and

[10] Annual Trade Report of Kenya and Uganda, Nairobi, 1928, p. 30.

hundreds of motorcycles and motorcars in a single year.[11] While one cannot attribute all of these benefits to the production of cotton, still it is the greatest single motivating force in the economic development.

This increase in wealth has had also its dark side. The natives have not yet learned the art of saving, and to many of them money is simply a means of securing immediate pleasure. Drinking, not only of native beer but also of European liquor, has increased greatly. This has led to more frequent indulgence in drunkenness, crime, and gambling, as is shown by the fact that the number of citations for these offenses have been mounting rapidly during the last few years.

COFFEE AND RUBBER CULTURE

Despite the rapid economic development that has taken place in Uganda, the prosperity of the natives has proven to be somewhat unstable. This is a condition which might be expected in a region depending almost wholly on a single money crop. Good yields and high prices result in prosperity, whereas poor crops or low prices bring about financial depressions and discontentment. At times the fluctuations are sudden and violent, as may be seen by the fact that in 1921 the value of the cotton export was less than one-third that of the previous year despite the fact that production had increased more than 50 per cent.

It is extremely difficult for the natives, not acquainted with the laws of trade, to understand these gyrations in prices. The result has been discontentment and hard times when values are low. The natives are prone to place the blame for these conditions upon the English traders, thereby endangering the good will which exists between the Protectorate and the Mother Country.

[11] *Ibid.*

FIGURE 12.—Many of the houses now have windows and some have chimneys and are surrounded with lawns and hedge fences (compare with Figure 7). (Courtesy of L. W. Kephart, Foreign Crops Division, U. S. Dept. of Agric.)

In order to overcome this danger, the Department of Agriculture has attempted to induce the natives to diversify their cash crops. The department has especially urged the production of coffee, and in 1924 it issued 140,000 Robusta coffee plants to the natives of southeastern Uganda.[12] Yet, the industry has not prospered. The natives prefer to grow a crop which gives more immediate returns. It requires years for coffee and rubber trees to mature, whereas cotton is ready for harvest within a few months after it is planted. Moreover, coffee and rubber trees are attacked by many insects and require more careful attention than the natives are willing to give them.

Plantation Agriculture of Europeans

For a time the production of coffee and rubber increased rapidly on the plantations of European settlers, but during the last decade both acreage

[12] Uganda Protectorate, Ann. Report, Dep't of Agr. 1924, p. 7.

and production have fallen off and rubber is produced only when prices are high.

It has been proven that Arabic coffee, the type grown most abundantly in Uganda, does not thrive at altitudes of less than 4,500 feet. As a result, many of the trees planted at lower levels have been cut down and, since there is but relatively little land above this area which is of easy access, the opportunity for expansion of Arabic-coffee culture does not seem bright. Robusta coffee does well at lower elevations, but European planters are but little interested in lowland development.

European settlers developed large rubber plantations in southeastern Uganda, but for some years the low price of rubber has rendered tapping unprofitable. During the years when rubber prices were low, these plantations were entirely abandoned and permitted to grow up in weeds and worthless trees. With the increase in rubber prices many of these estates, which were derelict, were brought back into cultivation.

THE OUTLOOK

During the past generation the natives of Uganda have made more progress than the peoples of Europe made in a thousand years when they were just emerging from barbarism. This rapid development has been due, of course, to the fact that the natives of Uganda have had civilization thrust upon them. Yet, this is not the first time that peoples from the temperate zone have stimulated progress within this area. During the last few thousand years there have been many invasions from the north, and the inflow of much northern and Asiatic blood; but once any given wave of immigration had been completed, there was a tendency towards retrogression again. Sir Harry Johnston has said that it is only by invasion from the north that the mid-African is kept from reverting to a more primitive state. Thus, in the light of history, one may ask if the present progress will continue.

The present attempt at development is fundamentally different from those of the past. Formerly, the invaders changed the environment but little: the area remained isolated; there was no scientific waging of war against malaria, sleeping sickness, dysentery, rinderpest, and other diseases of man and beast; but little headway was made in preventing the re-occurring famines as is now being done by diversifying crops, importing drought-resisting plants and improving transportation facilities. Moreover, the invaders adopted the native foods which, for the most part, are ill-suited to the development of a hardy people. Neither the plantain nor the cereal diet can be considered a balanced ration. In other words, the invaders accepted the environment as they found it and were unable to make progress under such conditions.

The present industrial development is closely related to the success in overcoming isolation, disease, and famine, and in improving the diet of the natives. That is, it is based on the improvement of the native and his environment, and not merely upon the injection of new blood and of a few more vigorous people.

The rapidity of development will not only depend upon the success in overcoming adverse environmental conditions, but also upon the degree of success in instilling in the natives a strong desire for the better things of civilization.

LOWER RIO GRANDE VALLEY OF TEXAS

William T. Chambers

Geographer, Stephen F. Austin State Teachers College

THE American part of the Rio Grande delta and some adjoining land in the Gulf coastal plain is a prosperous and progressive irrigation and dry-farming district. The inhabitants, numbering about 150,000, live in small, thriving cities and upon farms made by the subdivision of ranches, the removal of thorn-bush vegetation, and the installation of irrigation facilities. The production and marketing of early vegetables, citrus fruits, and cotton gives such abounding prosperity that immigration is attracted from other sections of the United States; and the population has increased rapidly during the last two decades. Modern homes, business houses, school and church buildings, and recently constructed highways and railroads impart a vigorous, progressive aspect to urban and rural landscapes, while areas occupied by mesquite, chaparral, prickly pear, and prairie grasses, in many cases used as cattle range, give a striking conception of the recent past of the region.

The Lower Rio Grande Valley is becoming an important commercial producer of early vegetables and citrus fruits. Subtropical location and position beside the warm waters of the Gulf of Mexico give the advantages of mild, almost frost-free climate, so essential to these industries. The average annual rainfall varies from 26 to 17 inches according to distance from the Gulf, and is supplemented by irrigation with water from the Rio Grande so that these crops grow abundantly on the fertile plain. Since the area is in the United States and is efficiently served by the Missouri Pacific and Southern Pacific railroad lines, it has the additional advantage of excellent access to the enormous American market for early vegetables and citrus fruits. These factors enable such effective competition with producing areas in California and Florida that carlot shipments of vegetables rose from less than 2,000 in 1912 to more than 17,600 in 1928; and, in the latter year, 1,183 cars of citrus fruits moved from the Valley.

Early Vegetable Crops

Early vegetable crops constitute the chief source of regional income at the present time. They are grown during the mild winter and spring months, and are marketed early enough to secure high prices as luxury commodities while fresh vegetables are relatively scarce. When competing districts located north of the Gulf of Mexico begin shipping a given vegetable, the price it commands in the North and East tends to become so low that Valley producers are unable to compete successfully in those distant markets. The intensive character, high productivity, and large return per unit of land employed commend vegetable crops to farmers in this region where land is expensive and water must be purchased for irrigation. They are more profitable than such staple crops as cotton and corn on the lighter, well-

drained soils, and have the great advantage of yielding an income a few weeks or months after planting. Therefore, many persons who plan to become citrus growers secure an income by the production of vegetables while their citrus plantings are below bearing age.

Cabbage is the great vegetable crop of the Lower Rio Grande Valley. Shipments have averaged almost 4,000 carlots a year since 1920, and in 1928 they numbered 5,915 or 33 per cent of the total vegetable movement from the region. Ability of the crop to escape injury during the occasional cold spells of winter, and the large capacity of the market commend it to growers. Cabbage is easy to harvest, and is so firm and durable that most of it is shipped in refrigerator cars without crating. These factors facilitate economical marketing, and enable distribution to ultimate consumers at prices much lower than those of most early vegetables, thus enlarging the buying capacity of accessible markets. Preference for fresh cabbage over cold storage stock enables the Valley crop to enter markets in the North and East during the winter and early spring. Florida offers competition throughout the season, and the crop of Alabama and Mississippi is on the market during May; but Texas has decided leadership in the early commercial crop, and most of the production is in the Lower Rio Grande Valley. The plants are set from seed beds into fields about the first of September. They are watered and cultivated at intervals until ready for harvesting in February, March, or April; when they are gathered, hauled to shipping sheds, and sold to buyers. A large tonnage of inferior cabbage is left in the field or rejected at shipping stations, especially late in the season and when prices are low.

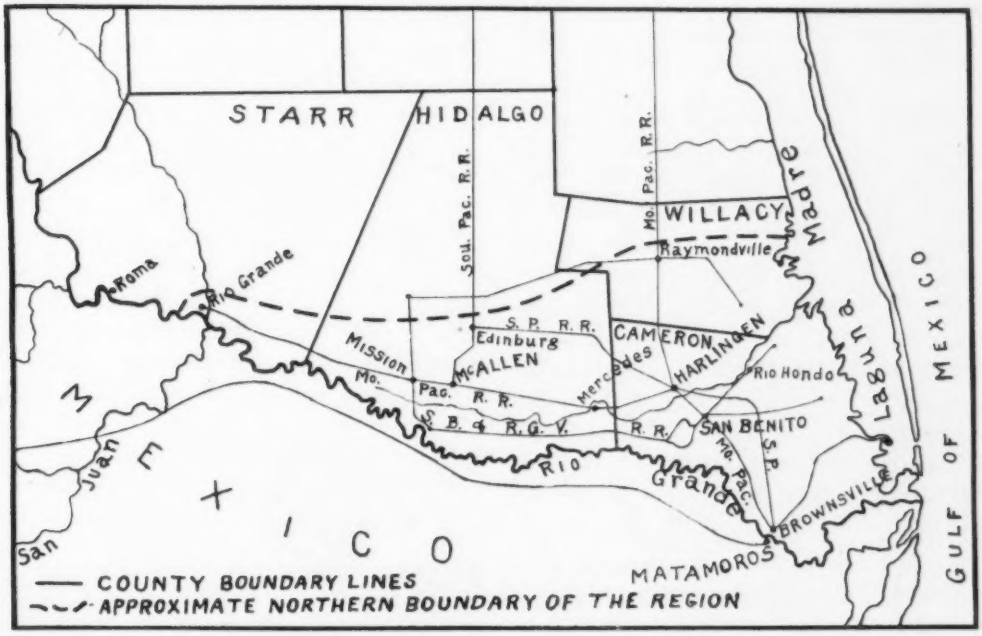


FIGURE 1.—Map of Lower Rio Grande Valley and adjoining areas.

FIGURE 2.—Until recently the Lower Rio Grande Valley was a land of mesquite bush, prickly pear, and prairie grass; and parts of it are still occupied by this sort of vegetation.

There is also a large commercial crop of early Irish potatoes. Mild winter temperatures, fertile silty loam soils, and an abundance of water for irrigation enable most growers to get their crops on the market during April. The output must compete with the cold storage stock of northern and eastern states and with the fresh crop of Florida. That this competition is being successfully met is indicated by the increase of carlot shipments from 175 in 1920 to 1,011 in 1925 and 1,567 in 1928. Chicago, St. Louis, and Kansas City are the largest buyers because of the great capacity of their respective trade territories and their greater proximity to the Lower Rio Grande Valley than to producing centers in Florida. Production is largely confined to areas of silty clay loam having good underdrainage which are located in Cameron County near Brownsville, San Benito, and Los Fresnos. Rapid increase of production reflects the strong demand and satisfactory prices producers have received for the crop. They are being educated in the proper grading and standardization of their pack by the Rio Grande Potato Growers Association, organized in 1925.

Tomatoes have become one of the leading early vegetable crops of the Valley in recent years. Only 185 carlots were marketed in 1920, but shipments increased to 342 cars in 1925 and in 1928 they amounted to 1,407 carlots. This crop requires more labor and is more perishable than potatoes; but it brings higher prices per unit of output, and yields abundantly. The heaviest production is in Cameron County, particularly about San Benito, Harlingen, and Brownsville; but large shipments are also made at Mercedes, Donna, and other centers in Hidalgo County. The crop is usually marketed during May and June, the first shipments being about two weeks earlier than those from competing areas located in eastern Texas and Mississippi. A small acreage is planted in the autumn for harvest during December. Tomatoes picked just before they begin to turn pink are wrapped in paper, crated, and shipped in refrigerator cars without icing as "greenwraps"; but much of the crop is marketed as "pinks" and requires refrigeration.

FIGURE 3.—Highly developed area near Harlingen showing palm-lined concrete highway with citrus grove in the background.

Several other vegetables are grown on a commercial scale in the Lower Rio Grande Valley. Carrots, beets, string beans, and green corn are especially important. All these

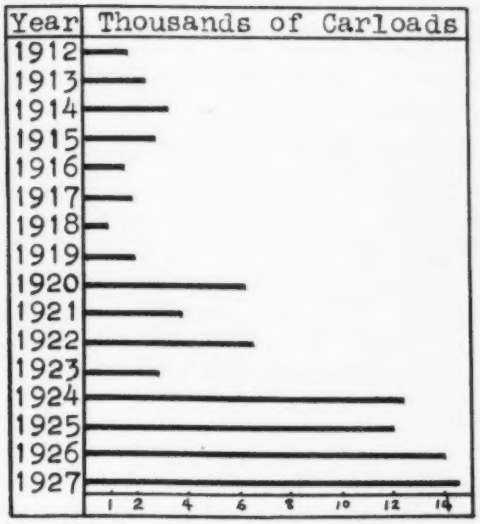


FIGURE 4.—Increase of carlot shipments of vegetables from the Lower Rio Grande Valley. (Data from Figure 1, Bul. 378, Texas Agric. Exp. Station.)

products, except carrots, are so perishable they do not meet competition from storage stock. Carlot shipments are confined to rather large cities, small centers having such limited capacity for these vegetables that the local dealers buy in smaller quantity. Many cars of carrots, for example, are taken by dealers in New York, Chicago, and several other northern and eastern cities; but none of the cities in Texas ordinarily buy in such large quantity. Hundreds of cars of beets and carrots packed "half and half" are shipped from the Valley, relatively small centers being able to absorb them in that quantity. Lettuce, watermelons, and onions are produced, but these crops are less important than in earlier years. Acreage is also devoted to the growth of rutabagas, turnips, spinach, asparagus, cauliflower, squash, green peas, eggplants, and some other vegetables. Quantities of all these crops are shipped in "mixed" carlots and by express.

Mixed carlot service has greatly facilitated the expansion of accessible markets for early vegetable crops of the Valley. Shippers offer to pack and consign cars containing three or more sorts of vegetables in any proportion specified by buyers. They assemble them from producers by truck, load them in refrigerator cars according to orders, and ship them promptly to patrons. This enables relatively small dealers to order the quantity and variety of available vegetables their market territories will absorb, gives independence of the great markets, assures receipt of vegetables while they are still fresh, and enables their sale at prices lower than would be possible if purchases were made in central markets or were shipped direct in small consignments from producing areas. Thus, mixed carlot service improves the quality and lowers the prices of early vegetables in hundreds of small cities and towns, and stimulates material expansion of the capacity of their respective market territories. These considerations account for the increase of Valley mixed car shipments from 343 cars in 1920 to 3,891 cars in 1925 and to 6,632 cars in 1928. They also give the region a distinct marketing advantage over those competing areas which produce only one or a few sorts of early vegetables on a commercial scale.

CITRUS FRUIT INDUSTRY

The Lower Rio Grande Valley is about as well suited to citriculture as areas in California and Florida which are now engaged in the industry. Location beside the warm waters of the Gulf of Mexico and in a more southerly latitude than Los Angeles or Tampa gives the region a mild subtropical climate. Records of the United States Weather Bureau in-

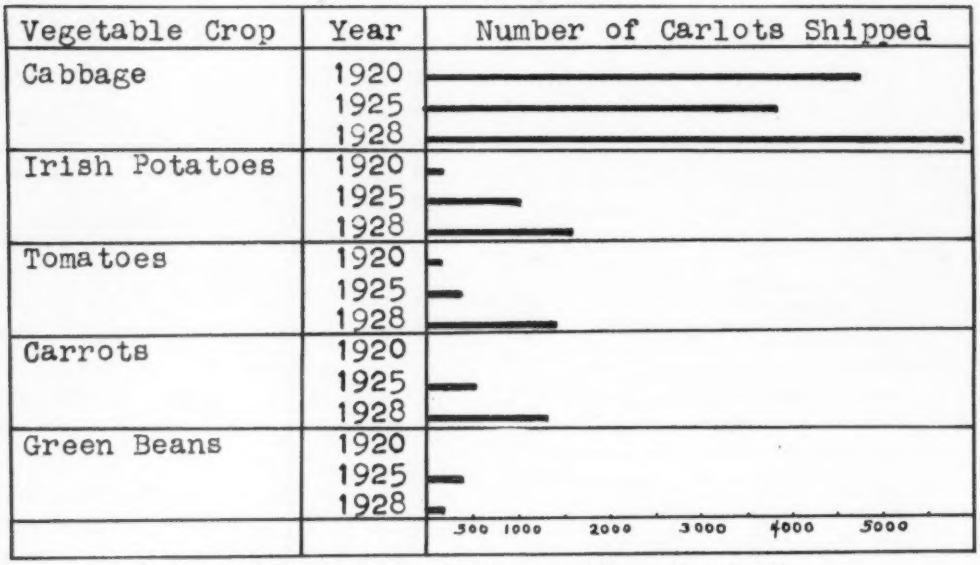


FIGURE 5.—Valley shipments of leading vegetable crops for selected years.

dicate that freezing temperatures occur considerably less frequently at Brownsville than at Redlands, California, or Eustis, Florida, cities located in citrus growing sections of those states. Although Brownsville has fewest frosts per year and there are fewer protracted cold spells than at Redlands, its absolute minimum record of 12° F. is lower than that of Redlands (18° F.) or Eustis (16° F.).[1] However, this is not considered a serious detriment to the industry. Years of practical experience indicate that there are few nights during the winter in which low temperatures necessitate the heating of citrus groves in the Valley, and no artificial heating is required during some years. It seems that the frost hazard in the Lower Rio Grande Valley is approximately equal that of proven citrus-producing areas in California and Florida with which it must compete in the American market.

The competitive position of the Valley is equally strong in some other respects. The alluvial soils and the Rio Grande delta, derived from relatively unleached materials in all parts of its large drainage basin, are doubtless richer in plant foods than the more stony soils of piedmont alluvial plains in southern California or the sandy coastal plain soils of Florida. Location of the Valley at the south-central extremity of the United States gives the advantages of cheaper and quicker service to markets in the western part of the Mississippi drainage basin than competing areas; and, although the area is farther from markets in the Northeastern States than Florida, it is much nearer to them than is California. Moreover, the water supply of the delta is sufficiently large to enable much expansion of citriculture without restriction of other industries. The average annual rainfall varies from 26.36 inches at Brownsville to 17.34 inches at Rio Grande City on the western margin of the region. This enables citrus production by dry-farming methods; but practically all commercial plantings are irrigated because it hastens

[1] See Figure 7.

FIGURE 6.—Carrots and beets at a shipping shed. (Courtesy of Harlingen Chamber of Commerce.)

development of the trees, increases their productive power, and fertilizes the land by the addition of silt. The quantity of water in the Rio Grande is limited, and its utilization must be shared with Mexico; but the average annual run-off at Brownsville, amounting to 4,320,000 acre feet, is large enough to enable much expansion of the irrigated acreage.

Citrus fruits seem destined to become the chief money crop of the Valley. Commercial plantings were first made in 1907, and interest in the industry has grown steadily, although it was hindered at the outset by scarcity of good nursery stock, a general lack of experience among citrus growers, and uncertainty as to the relative adaptability of different varieties to local soil and of climatic conditions. Courage born of success and knowledge gained by experience in production have increased with the passing years, plantings have expanded enormously, and citrus production has become an absorbing center of interest although the output is still relatively small and the great majority of trees are below bearing age.

The census of 1920 showed that there were 135,153 grapefruit and orange trees in Texas, but plantings have increased rapidly since then. The number of trees was estimated at 1,843,000 in 1925, and it is claimed that there will be 4,000,000 in the Valley by 1930. The increase of Valley citrus shipments from 451 carlots in 1926 to 1,193 carlots in 1928 indicates rapid growth of productive power as increasing numbers of trees attain bearing age. If the present rate of expansion continues, the Lower Rio Grande Valley will soon become a significant competitor of California and Florida in the American citrus fruit industry.

Grapefruit is the dominant citrus crop of the region. It is estimated that from two-thirds to three-fourths of all the trees are of this variety, and most of the remainder are

Average Annual Frequency of:	Name of Stations		
	Redlands	Eustis, Fla.	Brownsville
Spells of freezing weather	6.5	3.4	2.0
Days having freezing temperatures	12.9	5.0	3.5
Days having temperatures of 25° or below	9/17	28/32	21/29
Days having temperatures of 20° or below	2/17	6/32	4/29
Absolute Minimum Temperature	18°	16°	12°
Length of Record in Years	17	32	29

FIGURE 7.—Frequency and severity of freezing temperatures at stations in citrus-producing areas in California, Florida, and Texas.

orange. Definite specialization in the production of grapefruit is also indicated by the shipment of 1,024 carlots of that variety in 1928 as compared with 35 carlots of oranges and 124 carlots designated as mixed citrus fruits. This specialization in grapefruit culture is due to the preference given to Texas fruits in the American market. It is said that grapefruit grown in the Lower Rio Grande Valley contain more juice

FIGURE 8.—Rural home in a citrus grove near San Juan.

and are larger, sweeter, and superior in flavor to those produced in California and Florida. These unusual qualities are attributed to superior adaptability of Valley soils to the industry.

Interest in the culture of oranges is increasing, and there is some production of other citrus fruits. Carlot shipments of oranges increased from 6 in 1926 to 17 in 1927 and 35 in 1928. The movement will increase as new groves come into production and as bearing trees grow larger; but oranges will be unable to compete successfully with grapefruit for the attention of Valley citrus growers until varieties better suited to local conditions are secured. Although the Texas orange is quite juicy, its flavor is considered inferior to that of fruits produced in California and Florida; and this handicaps the marketing process and reduces the profits of growers. Lemons, tangerines, and kumquats are grown, but the output is too small to be of commercial significance.

THE COTTON CROP

Cotton is an important field crop in the Lower Rio Grande Valley. It is grown by dry-farming methods in unirrigated areas, and proves a profitable crop on irrigated land in most years. The output increased very rapidly after 1916 as shown in Figure 11 until it amounted to 167,086 bales in 1926. The enormous American crop of that year caused prices to reach such low levels that there was a violent constriction of production in the Valley. Rather heavy, low-lying clay and loam soils, unsuited for the growth of early vegetables and citrus fruits, are used in production. The staple ordinarily brings rather high prices for it is of good quality and comes on the market earlier than the enormous crop of the "Cotton Belt." As in other cotton-producing areas of the South, cottonseed oil is extracted from the seeds; and the cake, meal, and hulls are used as livestock feeds, fertilizer, and articles of commerce.

FIGURE 9.—Gathering grapefruit near Harlingen. (Courtesy of Harlingen Chamber of Commerce.)

THE RANCHING INDUSTRY

There is also a remnant of the ranching industry which was the basic occupation of the population as late as 1904. Since that time railroads have been extended into the area, settlers have been attracted, ranches have been divided into farms, and commercial producers of early vegetables, citrus fruits, and cotton have occupied much of the best land. Areas unsuited to these

relatively intensive uses have been avoided by agricultural settlers and are chiefly useful for cattle raising. Extensive areas in the northern part of the region, coastal flats bordering the Gulf of Mexico, and marshy depressions between intermittent dis-

FIGURE 10.—Young orange tree in the Lower Rio Grande Valley. (Courtesy of Harlingen Chamber of Commerce.)

tributaries of the Rio Grande are of this sort. Much of this land will be cleared and drained ultimately for use in farming; but at present it is occupied by native grasses and thorny shrubs, and is suitable only for use as pasture. Some of this land is held for speculative purposes, but part of it is stocked and supports a small cattle raising industry.

REGIONAL PROBLEMS

A comprehensive flood control project has been constructed to give protection from the Rio Grande. Elephant Butte Dam regulates water from the upper part of the drainage basin; but the erratic flow poured into the middle and lower courses of the river by the Conchos, Pecos, Salado, and other tributaries causes occasional flood in the delta. Here the relatively low banks and small gradient of the channel, together with heavy sedimentation due to decreasing velocity of current, conspire to increase flood frequency and intensity. As settlement of the Valley progressed, flood control became an increasingly pressing problem. At length the legislature of Texas remitted most of the state taxes in Hidalgo, Cameron, and Willacy counties for a period of twenty-five years each; and funds thus created, supplemented by local bond issues, were applied to the construction of flood control works. The project completed in 1928 consists of levees along the banks of the Rio Grande[2] and floodways bordered by levees through which flood waters collected west of Mission flow to the shore of Laguna Madre. The main floodway follows the course of Arroyo Colorado; and smaller intermittent distributaries of the Rio Grande, known locally as resacas, carry off much flood water.

The conservation and more efficient use of water are problems now pressing for solution. The Rio Grande, like most streams having semi-arid and arid drainage basins, has an erratic flow. The minimum annual run-off recorded at Brownsville is approximately a third of the maximum of 9,000,000 acre feet; and, although floods occur frequently, there are times when practically all the flow is used in irrigation. An agreement should be concluded with Mexico providing for the division of the water supply, the construction of reservoirs in which to impound flood waters, and their use in irrigation on each side of the international boundary. The average annual flow of 4,480,000 acre-feet at Roma probably could be made to

[2] Mexico constructed the levees on the southern bank of the river.

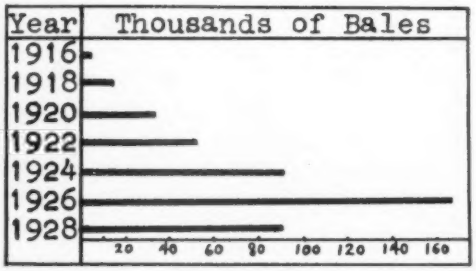


FIGURE 11.—Cotton ginned in Valley counties during selected years.

irrigate 2,000,000 acres as compared with 300,000 acres now said to be included in irrigation projects. The use of concrete-lined canals and underground distribution mains would save large quantities of water now lost by seepage to the injury of poorly drained low-lying lands. There is considerable agitation favoring these several improvements, and the adoption of a unified gravity system of irrigation to replace the many independent pumping systems now operating.

Drainage of low land to prevent the rise of the water table and alkali accumulation is also a problem in the Valley. The land slopes gently away from the Rio Grande and its flood channels (intermittent distributaries) so that water tends to accumulate in flats between natural levee ridges and along the shore of Laguna Madre. The heavy soils and depressed location of these flats retard their drainage and favor the development of marshes and shallow lakes. Irrigation of well-drained land has damaged adjoining flats by increasing the amount of water which drains into them. It has also increased the rate of alkali accumulation in these areas by augmenting the movement of salts in solution from higher land and by lifting them from the subsoil toward the surface where they come in contact with plant roots. Some large open ditches have been dug, and the land along them equipped with drainage systems which solve the problem locally. Facilities of this sort must be greatly increased as development of the Valley progresses.

Efficient transportation services are vital to the prosperity of the Valley. The income of the population is secured largely by the sale of perishable vegetable and fruit crops in distant markets. Thus, increased income is contingent upon improvement of transportation facilities as well as increased volume of production. Good highways and roads facilitate the assembling of truck and citrus crops at shipping points, and rapid efficient railroad services are

FIGURE 12.—View in residential section of San Benito, showing characteristic Spanish architecture.

indispensable to successful marketing of these goods in the North and East. An excellent concrete highway called the "Main Street of the Valley" extends westward from Brownsville to Starr County, and branch roads penetrate agricultural areas on either side. The Missouri Pacific and Southern Pacific railroads enter the Valley at Raymondville and Edinburg respectively and have lines extending through the irrigated and dry-farming sections. Coastwise shipments are made through Corpus Christi, and a Valley port is being developed at Point

Isabel which is connected with the interior by railroad and highway.

CONCLUSIONS

Development of the Lower Rio Grande Valley of Texas has been rapid during the last two decades, and there is much promise of continued growth. Truck farming for early market is the chief industry, the leading crops being cabbage, potatoes, and tomatoes. It will remain important, but citriculture is an absorbing center of interest and promises to gain ascendancy. The grapefruit crop is so excellent that growers specialize in its production, and it thoroughly dominates the citrus industry. There is a large cotton crop, and much land is still used for cattle raising. Canning factories are being established, and there is some manufacturing for local markets.[3] The area contains several small cities and thriving towns, most of them less than twenty years old. The population consists of prosperous Americans and many Mexicans, the latter constituting a cheap and efficient labor supply. Such pressing problems as flood control, soil drainage, the conservation of water, and the improvement of transportation facilities are being solved. The mild climate, progressive population, growing communities, verdant citrus groves, picturesque Spanish architecture, and stately palms lend distinctive quality to the landscape, and make the area a pleasant and attractive place in which to live.

[3] Natural gas and coal obtained near Laredo, local steam-electric plants and potential hydroelectric power from the Rio Grande offer abundant sources of fuel and power.

LAND UTILIZATION IN THE ST. FRANCIS BASIN

Sam T. Bratton

Geographer, University of Missouri

THE St. Francis Basin is the most northern of several similar "basins" of the lower Mississippi River. This Basin is differentiated sharply from adjacent areas mainly by soil types, drainage conditions, and marked topographic features. The nearly level alluvial lands of the Basin are terminated abruptly at its northern end by the Ozark Bluffs; the western and southern boundaries are formed by a curving ridge which effectively separates the St. Francis from the Black River and White River Basins; and, along the eastern side, there are low-lying wet lands between the protecting levee and the Mississippi River. Thus, the Basin is marked as a natural region. The activities of the people are largely agricultural, and are closely related to, and within broad limits are defined by, the natural environment; these characteristics give the area a considerable degree of geographic unity (Fig. 1).

In the northern part of the St. Francis Basin farm practices, in general, are similar to those in the corn belt, and in some sections the cultural landscape, showing fields of wheat, corn, and pasture, and neatly arranged homesteads with shady yards, barns, and, in many cases, windmills, strongly reminds one of that region. In the southern part in marked contrast, farming practices, in general, are similar to those in the cotton belt, and the cultural landscape presents seemingly endless fields of cotton, plantation homesteads, and grouped cabins of negro tenants (Fig. 2). Such contrasts are due largely to the location of the Basin along the contact of the corn and cotton belts. The region, in fact, affords one of the striking examples of the intimate contact of these two distinct farming types.

Although one sees fields of cotton, corn, and wheat in any part of the Basin, the proportionate amounts of improved land used for each of these principal crops vary markedly from north to south, and in different communities both north and south. In the northern district more land is used for corn and wheat than for cotton, while in the central and southern district more land is used for cotton than for corn and wheat. In the northern corn and wheat district there are, however, sections, as in Stoddard, Mississippi, and Scott Counties, in which half or more of the improved land is used for cotton; and, in the cotton-growing district there are sections in which 10 or 15 per cent of the cultivated land is devoted to corn and wheat, as near Wilson, Arkansas. On the R. E. Lee Wilson plantation, at Wilson, Arkansas, about 1,000 acres of wheat, and 4,000 acres of corn are grown each year, in addition to about 10,000 acres of cotton. However, such sections, which differ markedly in land utilization from their surroundings, may be considered merely as "outliers," the presence of which emphasizes the transi-

FIGURE 1.—Map showing location of St. Francis Basin.

tional character of agriculture in the Basin.

area, in the proportionate amounts of improved land used for the major field crops.

In the northern district, which includes about one-fourth of the Basin, a considerable part of the improved land in most communities is used for wheat and corn grown for cash, and for subsistence crops; but in some communities in this district a part of the improved land is used for the growing of cotton, an additional cash crop. The proportionate amounts of land used for each of these crops in this district is illustrated by the percentages (1923) for Mississippi County, Missouri, a typical area: wheat, 41 per cent; corn, 32 per cent; cotton, 15 per cent.[1]

In the central-southern district, which includes about three-fourths of the Basin, the cash crop is cotton, with some corn as a cash and subsistence crop. The proportionate amounts of land used for these crops

FIGURE 2.—View of St. Francis Basin looking east from Crowley's Ridge.

USE OF THE LAND IN FARMS

Although the most important industry in the St. Francis Basin is agriculture, there are marked contrasts between the northern and the central-southern districts and, in different communities in any general are in marked contrast with those in the northern district. Such contrast is illustrated by the percentages (1922) for Crittenden County, Arkansas, a typical area: cotton, 72

[1] *The Monthly Bulletin:* Missouri State Board of Agriculture (Jefferson City, July, 1924), XXII, No. 7.

per cent; corn, 21 per cent; wheat, less than 1 per cent.[2]

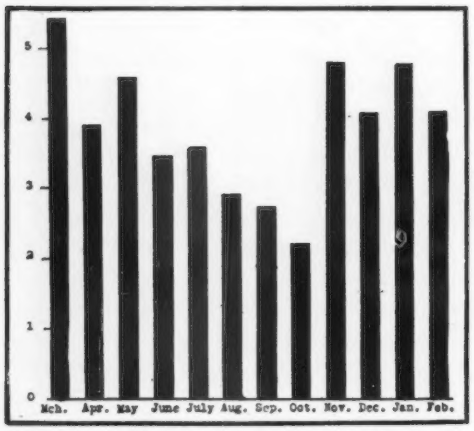


FIGURE 3.—Rainfall record at Osceola, Arkansas, over a period of thirty years, 1892–1922. Figures are in inches. (U. S. Weather Bureau.)

In addition to the major field crops practically every farmer throughout the Basin grows some subsistence crops such as truck and vegetables in varying amounts. In a few communities, widely separated from one another, a few special crops, as melons, berries, seeds, and fruit, are grown for market; but the combined acreage of all such crops, and the income derived from them, are almost negligible when compared with the acreage and incomes associated with the major field crops. Similarly, a few farmers produce some dairy products for market. In a few places one finds a farm devoted to the rearing of blooded cattle, or hogs. However, truck and livestock farming are not common, and as one travels in any general part of the Basin, the vista of cultivated fields rarely is interrupted by any other outstanding agricultural activity.

[2] Ferguson, Jim G., Commissioner: State Bureau of Mines, Manufacture and Agriculture, *Arkansas Crop Report* (Little Rock, 1923).

THE COTTON GROWING DISTRICT

In the central-southern three-fourths of the Basin, most of the cropped land is used for the growing of cotton. This crop increases in dominance toward the south, in which section it has been a part of the farm economy for a greater number of years than in the central section. This southern section is near the cotton South. In fact, it is across the Mississippi River from western Tennessee, and from the northern part of the Yazoo Basin, two regions where cotton has been grown for more than one hundred years.

Most of the farms in the cotton growing district are less than fifty acres each (Table I), and, in general,

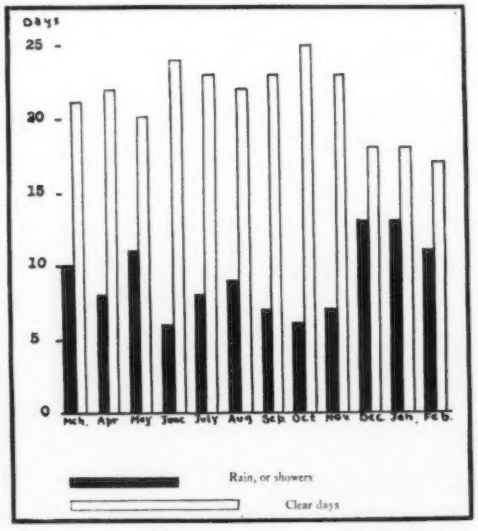


FIGURE 4.—Sunshine record at Osceola, Arkansas, over a period of thirty years, 1892–1922. (U. S. Weather Bureau.)

the farmer is not the owner of the land. As a rule the large land holdings are divided into tracts varying in size from ten to one hundred acres each. These small tracts are leased to cotton farmers.

FIGURE 5.—Typical negro cabin on the W. W. Driver plantation. Two of the children are standing on the platform of the well, an iron pipe driven into water-bearing strata. At the top of the pipe is a small suction pump.

TABLE I

SIZES OF FARMS, AND FARM OWNERSHIP, IN FIVE TYPICAL COUNTIES

(U. S. Census, 1920)

County	*Total Number of Farms*	*Number of Farms Less Than Fifty Acres Each*	*Per Cent of All Farms Operated by Tenants*
Mississippi (Mo.).....	1,184	306	72
New Madrid (Mo.)...	2,025	764	79
Pemiscot (Mo.).....	2,533	1,752	72
Crittenden (Ark.)....	5,496	5,029	90
Mississippi (Ark.)....	6,516	5,407	83

On some plantations, such as the R. E. Lee Wilson plantation, near Wilson, Arkansas, and the W. W. Driver plantation near Osceola, Arkansas, the resident owner farms a considerable part of the land. Other lands on these plantations are leased in small tracts to tenants.

As a rule the terms of lease are made to suit the tenant. The land holder wants the land cropped, hence the tenant is given several options; he may pay cash rent, crop rent, or cash and crop rent, and he may or may not furnish his own seed.

Land ownership and the leasing system have a direct bearing upon the utilization of the cropped land. Land owners require their tenants (1) to grow cotton, because the cash value of crop rent per acre of cotton is more than that of any other general field crop (Table II), or (2) to pay such high cash rent per acre that they are forced to grow cotton in

FIGURE 6.—Homes of negro tenants on the W. W. Driver plantation near Osceola, Arkansas.

FIGURE 7.—Typical home of white tenant farmer.

order to pay the rental charge.[3] Further, the custom of accepting a prospective cotton crop as collateral for loans, and that of making accounts, notes, and mortgages fall due at cotton picking time, customs that are in turn adaptations to cotton farming, tend not only to favor the continuation of cotton growing by established farmers, but also to induce newcomers to engage in cotton farming. The net value of cotton, per acre, over both corn and wheat, is one of the reasons for the dominance of cotton, especially in the southern section of the Basin.

TABLE II

COMPARATIVE NET VALUES OF THE MAJOR FIELD CROPS

(Computations made from data obtained from Missouri Farm Record, 1922, and the Arkansas Crop Report, 1922.)

Crop	*Cost of Producing One Acre*	*Gross Value Per Acre*	*Net Value Per Acre*
Cotton	$33.57	$60.40	$26.83
Corn	23.60	30.05	6.45
Wheat	18.97	14.35	—4.59

FIGURE 8.—Various types of machinery used in preparing the land, and in planting cotton. The wagon contains fertilizer—nitrate. One of the machines puts the nitrate into the tops of the ridges; another plants the seed. The boys with the long-handled hoes are on their way to "chop" a field already up. (Driver Plantation.)

[3] Cotton land rents from fifteen to twenty dollars per acre. Personal information, Abner Driver, proprietor of "Rainey Colony," Osceola, Arkansas. Mr. Driver has about two hundred and thirty white families on his "Rainey Colony" plantation, and rents all the land on a cash basis Average gross value per acre of cotton on this plantation is about $100, when cotton is selling around 15 cents per pound.

Most of the farmers who own their farms, and some of the renters, grow

a few field crops in addition to cotton. Such crops are grown because of (1) certain conditions of the natural environment, (2) insufficient labor to grow cotton on all the available plow land, and (3) economic needs of the family.

On practically every farm of as much as 50 acres there are small

FIGURE 9.—Dragging cotton ridges on the W. W. Driver plantation near Osceola, Arkansas. "Uncle Ed Black" has been on this plantation for more than forty years.

patches of heavier lands. Such places, because of soil texture or poor drainage, are not as desirable for cotton growing as the sandy loams. On some farms small patches are planted in subsistence crops, as corn or wheat, or in forage crops, as clover or alfalfa. In Mississippi County, Arkansas, corn is not grown as a money crop, but mainly as a subsistence crop. Farmers plant a small field of corn if they have time, after giving cotton attention. Such crops are planted, cultivated (if corn), and harvested at such times as labor can be spared from the cotton fields. But the cotton crop requires very frequent attention from early spring until late fall or early winter, and especially during the months of May and June. During the summer months the corn also needs cultivation and the forage crops need cutting. Therefore, the farmer who grows from ten to twenty acres of cotton, and who must rely mainly upon his own labor and the labor of his family, has but little time to give to secondary crops.

Little attempt is made in any part of the district, in some parts none at all, to rotate the subsistence crops with cotton, however desirable the practice might be. The general tendency is to resort to the use of fertilizers to maintain yields.

A few of the plantation owners, and owners of fairly large farms, grow some corn, wheat, and forage crops in excess of what is needed for domestic use, or for livestock on the farm. This practice is exceptional rather than general, and as a rule the planter or owner of considerable farm land grows only enough crops of diverse kinds to supply the needs of the plantation or farm. When one remembers that some of the plantations employ as many as 2,000 laborers who must be fed the year around, and from 800 to 1,000 work animals, one realizes that considerable corn and wheat is a necessary part of the farm economy.

In the cotton-growing district practically all the land that is cleared and that can be plowed is used for field crops, but on many farms containing as much as fifty or more acres each there are patches of timber along the swales and undrained bayous. These patches are used for pastures. They are supplemented by small fields of clover or alfalfa, and by the stubble fields or stalk fields after certain crops have been harvested. However, in some sections as along the King's Highway between Blytheville and Osceola, one travels for miles and sees no pastures of any kind, only fields of cotton, with here and there a field of corn or wheat. In the distance the scrag-

gly trees indicate swale or swamp, and upon examination one finds these distant woodlands are supporting a few cattle and pigs. But the district is not a livestock district primarily; above all else it grows cotton. All other crops are subordinate to this one, and all farm economy is so planned that the maximum time, labor, and land may be given to its production.

FIGURE 10.—Typical farm home in the mixed farming district. The trees are native. Near the house one may see a corn field.

THE MIXED FARMING DISTRICT

In some ways the cultural landscape in most sections of the mixed farming district in the St. Francis Basin resembles that of a prosperous farming area in the corn belt.

Many of the farms contain 200 or more acres each, with fine homes in well cared for, grassy, shady yards. Nearby are big red barns and white silos, and in pastures of grass or other forage one may see well-bred cattle and hogs. The major field crops are corn, wheat, clover, and alfalfa. On most farms of this type, cotton is not grown.

On the farms which contain from 40 to 160 acres each, the farm buildings are smaller and fewer than on the larger farms, and the cultivated lands, like those on the smaller corn-belt farms, are used primarily for field crops with less attention to grass and livestock than on the larger farms.

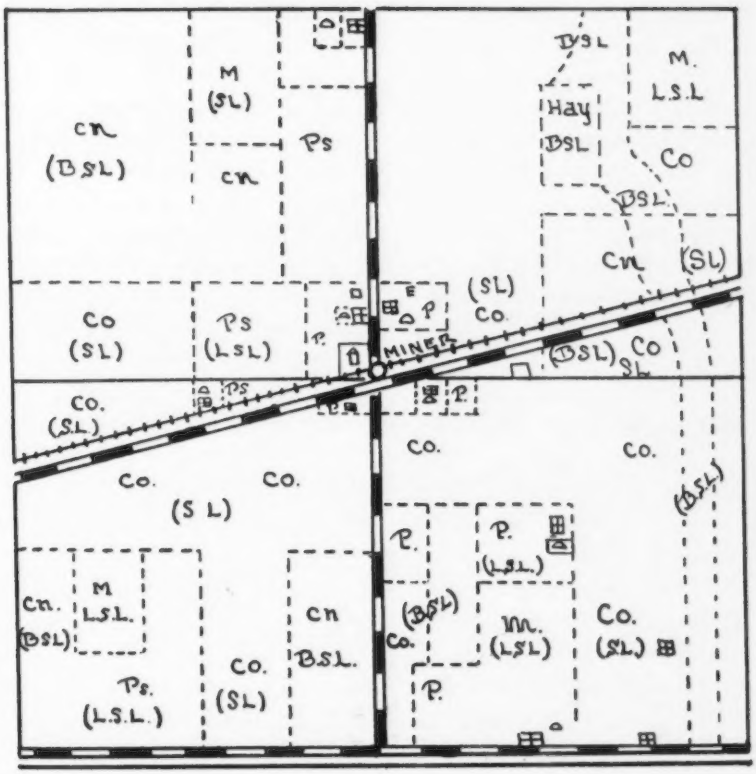
Almost any part of the mixed farming district comprising as much as three or four sections of land has about as many farms of varying sizes as any other part, and about as many farm owners.

In selecting lands for various crops, the farmer, as a rule, is influenced partly by general farm practices in the community and partly by the natural environment.

Newly cleared lands are used for corn for two or three years, or until tillage has removed most of the roots and stumps; less stumpy lands are used for corn or pastures, and the land free from stumps is used for corn, wheat, cotton, truck, forage, and pastures.

Soil variations, except in areas of light sandy loams, have but little bearing, in general, upon field crop selection because practically all soil types represented are fertile alluvium and differ chiefly in sand content only. However, gardens and truck patches, as a rule, are on the lighter sandy loams because (1) such lands are easily tilled by hand, and (2) it is desirable to have them near the house, which, in most cases, is situated on the relatively higher, sandier land. On the farms in the northern district where cotton is produced, it is commonly grown on the sandy loams because it can be cultivated there with less labor and at less cost than on heavier lands.

Economic activities, in general, in the mixed farming district are fairly illustrated by the activities in an area comprising a section of land in the light sandy loam region east of Sikeston, Missouri (Fig. 11). Land utilization in this area is typical of that in most of the mixed farming



Land Utilization one square mile in mixed farming district near Sikeston Missouri.

⊞ Homesteads	++++ Railroad
⌓ Garden	▬ Hard surface road
Co. Cotton	═ Earth road
Cn. Corn	SL Sandy loam
Ps Cow Peas	BSL Black sandy loam
M. Meadow	LSL Light sandy loam
P. Pasture	----- Soil boundary

FIGURE 11.—Land utilization on one square mile in the mixed farming district, near Sikeston, Missouri.

district, although some contrasts are apparent. For example, during 1924 some sections of the district grew more wheat, proportionately, than

the Sikeston Area; the latter, on the other hand, had a greater proportionate amount of land in secondary crops, such as cowpeas and melons, than had most of the district. In the Sikeston area, moreover, a larger proportion of the land was in cotton than was the case in some other sections of the mixed farming district. However, because of partial failure of the cotton crop, due to an early frost, many of the farmers on the Sikeston area grew more wheat and less cotton in 1925.

In the Sikeston area one may see rather large, rectangular fields of corn and of cotton, and smaller fields of hay, melons, cowpeas, or pasture. The homesteads of the farmers, marked by a few shade trees, are located along the roads. Houses in general are of one story, frame construction. Near the house is a garden in which are grown vegetables for family use. A short distance from the house is the barn which, in most cases, is made of boxing with shingle roof, and is framed on posts rather than on sills and foundation.

The principal crops in this section are corn and cotton. In 1924 these two crops occupied more than three-fourths of the cropped land in about equal proportions. In general, corn is grown on the heavy sandy loams and cotton on the intermediate sandy loams. Some of the corn fields are considerably narrower than most of the cotton fields, because the strips of heavy sandy loams, which occupy the lower lands, are not as wide as the sandy loams which occupy the higher lands. Fields, as a rule, are longer in the north-south direction than in the east-west direction, due to the fact that the alternate sandy ridges and strips of relatively lower lands trend in a north-south direction. Some of the intermediate sandy loam lands are used for pastures and some for cowpeas, but as a rule cowpeas are grown on the light sandy loams. Some of the farmers in this area grow patches of watermelons on the intermediate sandy loams, but melon growing is not of general importance in the mixed farming district. In a few places, such as near Blodgett, where there is quite an extensive area

FIGURE 12.—Wheat field in the mixed farming region near Sikeston, Missouri.

of sandy loams, melons are grown commercially.

THE TRANSITIONAL ZONE

The area near Risco shows some striking differences from that near Sikeston. In the former, the farms are smaller and the houses newer, and in general smaller. A greater proportion of the cultivated land is used for cotton and corn and a less amount for hay and pasture than in the Sikeston area. As a consequence, one sees fewer livestock in the Risco area.

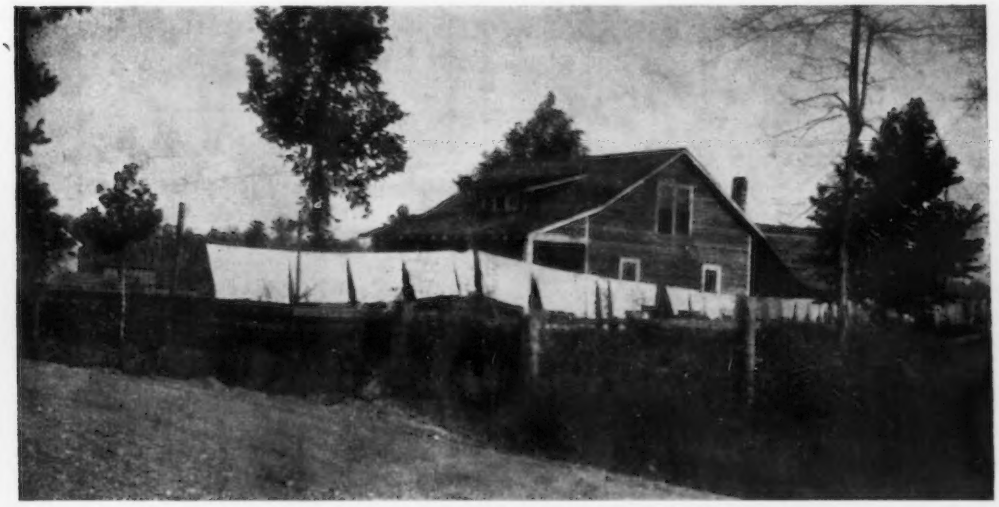


FIGURE 13.—Typical farm home in the transitional farming district, near Risco. The newness of this section is indicated by the fences, the abundance of trees, and the unpainted condition of the house.

In general, any part of the Risco area is similar to any other part. This transitional zone is in the lowland between Sikeston Ridge and Dunklin Ridge and is included within the St. Francis Drainage Project. The use of the land in this area is illustrated by a section near the town of Risco (Fig. 14). Cotton and corn, the principal crops, occupy some 80 per cent of the land and proportionally are about equal. The acreages of corn and cotton which any one farmer grows depend largely upon the amount of labor available. As a rule, a farmer near Risco pays little attention to soil selection for the different crops, because in this section the soil is practically the same throughout, black sandy loam. Some farmers use all their cultivated land for cotton, others use all their cultivated land for corn, and some grow both cotton and corn.

On practically every homestead in this area is a grove of trees which has been left to furnish shade for the buildings. At some of the homesteads there is a wood-lot used for pasture for the work animals and for fuel supply. Practically every house has near it a small garden patch, which, as a rule, is fenced with palings.

The newness of this area is evidenced by the trees remaining on the homesteads, by the stumps in many of the fields, by the new boards in houses and barns, and by the uncompleted fences. The general appearance of the farm as a whole indicates a stage of improvement rather than one of stability.

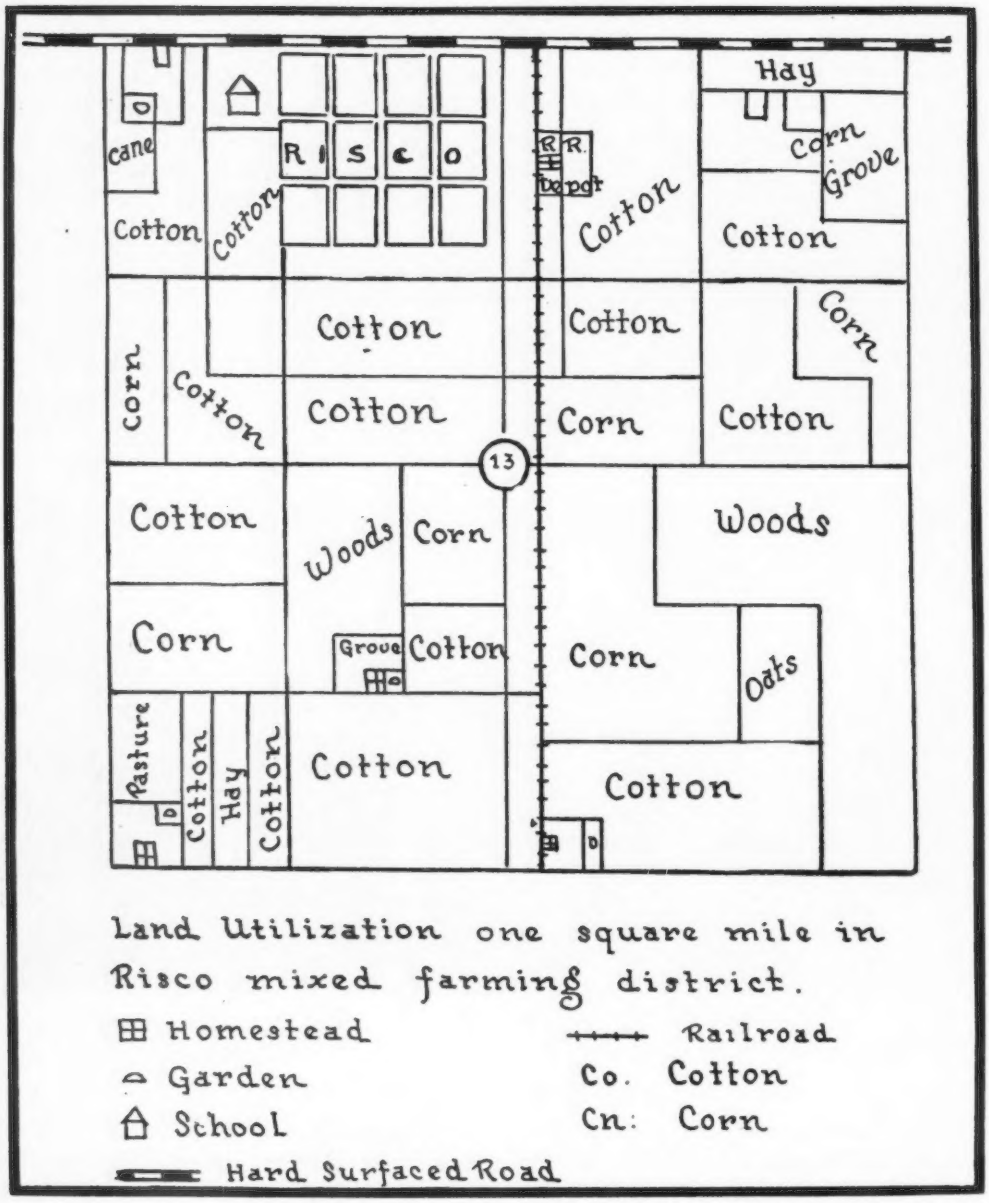


FIGURE 14.—Land utilization on one square mile in the Risco mixed farming district.

USE OF THE LAND NOT IN FARMS

The amount of land not in farms in the Basin is about 40 per cent of the entire area, but the proportionate amounts of such lands vary widely from place to place. In some parts, such as the Sikeston area, practically every acre is improved farm land; in other parts, such as the southern section of Mississippi County, Missouri, considerable areas are unimproved and not in farms.

The lands not in farms have certain economic relations to the general areas in which they are located. The

FIGURE 15.—Typical rural school in the transitional farming district. Nearby is a field of corn. Across the road (left, but not visible in the picture) is a field of cotton. In the background is uncleared land.

remaining forested sections furnish timber for the lumbering industry; some of the cut-over areas are used as range lands for livestock.

The most important auxiliary industry is lumbering. This industry is carried on by large commercial companies and by many operators of small local mills. With the exception of some half dozen areas varying in size from a few hundred to a few thousand acres, all the virgin timber which could profitably be taken out by large concerns is gone. At present four large lumbering companies are operating in the region, none of which has timber in sight to last more than a few years. In fact, one of these companies, the Dillman Egg Case Company at Caruthersville, is now getting all of its timber from the banks and islands of the Mississippi River between Cairo, Illinois, and Memphis, Tennessee. The company uses a fleet of barges to bring the logs to the mill.

The Chicago Mill and Lumber Company, which operates a large mill near Blytheville, Arkansas, owns some of the larger stands of virgin timber, and brings logs to its mill by short railway lines from the timber areas some five to seven miles distant. The commercial mill at Marion, Arkansas, uses huge eight-wheeled wagons drawn by six and eight mule teams to bring logs from its holdings some three to five miles distant (Fig. 18).

The large mills, on the average, each cut from 12 to 15 million board feet each year, and manufacture therefrom a variety of products, as boards, timber, shingles, crates, shooks, and staves. Some of the timber of the region is not well adapted for first-class lumber, and from such timber the boxes and crates are made.

Lumber products are marketed mostly in the Mississippi Valley, and are mainly distributed from Kansas

FIGURE 16.—Typical drainage ditch in the St. Francis Basin. Trees cut but stumps not removed ahead of the dredge boat. Growth of timber is typical.

City, St. Louis, and Chicago. The Dillman Egg Case Company at Caruthersville, Missouri, sells its egg cases and crates in the states of Iowa, Wisconsin, Minnesota, Nebraska, and Missouri, where large quantities of poultry and eggs are produced.

The relation of the lumber industry to environmental conditions in the region may be illustrated by the activities of the Himmelberger-Harrison Lumber Company at More-

house. This company owns timber lands in various parts of the St. Francis Basin and manufactures boards, posts, shingles, shooks, and staves. Most of its saw timber is brought to the mill at Morehouse by log trains from cuttings as much as twenty-five miles distant. The company has extensive lumber-producing machinery at Morehouse, as well as extensive drying yards. Products of the mill show a marked relation to the character of the timber now available; from the larger trees, high-grade timbers, boards, and shingles are produced; while the small, inferior trees are made into posts, less desirable lumber, barrel staves, and heads.

The relative importance of this industry to the locality is indicated by the fact that, at the present time, general business conditions at Morehouse and in the surrounding community depend more upon the agricultural industry than upon lumbering. However, some years ago practically the only economic activity in the Morehouse area was lumbering.

Some of the lumber produced by the mill finds a ready market in the St. Francis Basin. Products not marketed in the immediate vicinity are shipped by rail mainly to St. Louis, or to Memphis, and from these points are distributed to consuming areas.

In addition to the few large sawmills, there are many small ones in different parts of the Basin. These small mills are using the few large valuable trees, and the poorer quality trees, left by the commercial companies, together with the larger, second-growth trees. Their products are mostly second-class boards, railway ties, and telephone and telegraph poles.

Some of these small mills are located along the railways, and thus have access to market. Such as are not so located use wagon transportation to the towns, or to railway ship-

FIGURE 17.—Typical cypress slough in the area between the levee and the Mississippi River. Areas such as these effectually separate the Basin from the river.

ping points. Because of the wet condition of the roads from the small mills in the low ground to the highways or to the railways during most of the year, many of the lumber wagons have wide-tire, solid wooden wheels, made by boxing an ordinary spoked wheel. The wide tire cuts less deeply than a narrow tire, and the solid wheel prevents mud from accumulating between the spokes.

Logs are brought to the mills in various ways which reflect the conditions under which the industry is carried on, and the difficulties with which it must contend and in part overcome. Logs from a distance of a mile or more are brought on wagons, or on carts by suspending one end of the log from the axle of the cart and by dragging the other end on the ground. If the distance is not too great, the logs are dragged in shallow mud runways, along which they slide quite easily. The team of mules, or the single mule dragging the logs, walks by the side of the mud slide. It is not uncommon to see a mule taking a log along a slide without the direction of a driver. The mule is started by the man in the timber. He knows where to go and how to get there without a driver, and he does it faithfully. On the return journey, however, he is apt to take advantage of his liberty and browse on the way.

Whenever a small mill has worked out the timber within a mile or so of its location, it moves to another site, if one is available; if no site is available, the mill goes out of business. Abandoned mill sites are common, and in not a few places one sees rusty boilers, suggestive of the passing of the lumber industry.

FIGURE 18.—Type of wagon, eight wheels, and team used to bring logs from the lowlands to the mill at Marion, Arkansas.

OTHER USES OF UNIMPROVED LANDS

The use of unimproved lands for the grazing of livestock, because of several contributing factors, is not an outstanding economic activity in the Basin. The people are engaged primarily in the production of crops, and possess only such animals as are needed in this activity.

The major portion of the unimproved lands consists of cut-over or forested areas. The undergrowth on such lands is, in the main, brush and weeds rather than grasses. The paucity of grazing vegetation to-

gether with the difficulty of finding the stock in the thick growths, has a tendency to discourage the livestock industry on the unimproved lands. As a result of such unfavorable conditions, most farmers prefer a small fenced pasture, or woodlot, for the few head of work animals and the family cow. Rarely does one see much livestock in the cut-over or forested areas.

In addition to their value as sources of timber and as pastures, the cut-over and forested lands contain considerable numbers of small game animals, game fowls, and fur-bearing animals. Such resources are of some value. Game animals (as squirrels) and game fowls are used for food, and in no small degree supplement food supplies produced on the farm, or purchased from the store. The pelts of the fur-bearing animals, as muskrat, trapped along the marshes, ditches, and in the timber, bring a supply of ready cash at a time when wages are not obtainable, and when there are few, if any, farm products available for sale.

Considerable areas of land, in total, are required for drainage purposes, either for the original streams and bayous, which in some cases have been widened and straightened, or for the artificially constructed ditches, levees, and impounding areas. Although a ditch is perhaps but a score of feet wide, the earth ridge along each side is likely to be several times as wide as the ditch, so that the actual amount of land used for a given ditch is considerable. Larger ditches require proportionately larger amounts of land, and a well-developed drainage project is likely to use as much as five per cent or more of the land in a given area.

Other lands not in farms are used for highways, county roads, cross roads, railways, and village and town sites. The total amount so used is no small part of the land in areas where the farms are small, the transportation systems well developed, and where there are many towns and villages within a few miles of one another. In this connection it is well to remember that many of the roads follow high ground, and that the villages and towns, in most cases, are located on the higher, better drained lands—lands desirable for farming purposes.

THE LIME INDUSTRY AT ROCKLAND, MAINE[1]

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THIS study of the evolution of one of New England's smaller industries, an industry having its beginnings in pre-Revolutionary days, was undertaken because it epitomizes the developments which have taken place in other and greater industries during the past two centuries. New England has always ranked low in its stores of raw materials for manufacturing, and this applies particularly to mineral resources. It is well known that the states of this region lack coal and iron-ore and nearly all other useful metals and minerals. The presence, therefore, of so important a raw material as limestone of suitable quality for the manufacture of lime is a noteworthy industrial fact for New England. The use of lime in connection with the erection of buildings of stone or brick has been known to the civilized portion of the world since ancient times. Modern science has found many more uses for lime, examples of which may be seen in the use of lime in the refining of sugar, the enrichment of soils through liming them, or in sanitation for which chloride of lime is employed. The greater the number of purposes for which lime may be utilized the greater becomes the importance of limestone deposits, the raw material from which commercial lime is manufactured.

The rocks of New England are composed, in the main, of the different varieties of crystalline and igneous types, but there are two limestone regions, one along the western border of the New England province extending upward through Connecticut and Massachusetts, and the other on the coast of southern Maine in Knox County which borders on the west the estuary of the Penobscot River. Rockland, a city of about 9,000 population, is the center of the Maine limestone exposure and development. Although this region is much smaller than the other, the Rockland lime industry surpasses that of any one place in Massachusetts or Connecticut. A brief sketch of some of the outstanding changes, both industrial and social, in connection with the manufacture of lime in Knox County during the past two hundred years is the purpose of this paper.

Early History

The first recorded example of the burning of lime in Knox County was in 1732 by Samuel Waldo, who had secured a grant of land from King Charles and founded the colony of Waldoboro, south of the present site of Rockland. His product found a ready market at Boston since that city had no limestone in its vicinity

[1] The writers are indebted to Mr. F. E. Harrington, who made accessible much of the material in this paper. Mr. Harrington, now a resident of West Hartford, Conn., formerly lived in Rockland.

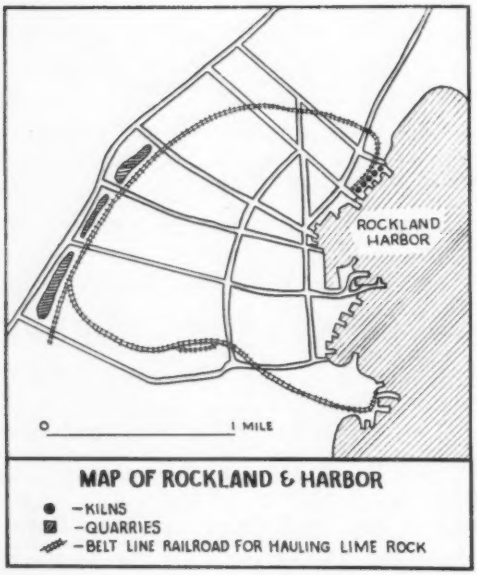

FIGURE 1.—Map of Rockland and Rockland Harbor, showing kilns, quarries, and belt line railroad for hauling lime rock.

and since, further, the water route to Boston was direct and short and ships were plentiful for carrying on trade.

Next came General Knox, Washington's chief of artillery in the Revolution, who had settled on a tract of land given to him by the Government in what is now the town of Thomaston. In 1792 he began to carry on the burning of limestone and the selling of lime. It was not long before cargoes of lime were being sent to New York, and after a few years the business had expanded to such an extent that shipments were being made to practically all the ports along the Atlantic and Gulf Coasts —Norfolk, Charleston, Savannah, Mobile, New Orleans, and Galveston. In more recent years the growing competition of the developing West, aided by excellent transportation facilities, has cut off many of the more distant markets, but Boston and New York have always remained large centers of consumption of Rockland lime.

EXTENT AND QUALITY OF ROCKLAND LIMESTONE

The limestone deposits which have proved so valuable for Knox County are quite limited in extent, running but a few miles parallel with the coast through the towns of Rockport, Rockland, and Thomaston. The industry is centered at Rockland because of its harbor facilities and the easy accessibility of its limestone beds. The Rockland limestone is much folded and crumpled like all the rocks of Maine. The color of the stone is a pronounced gray with inconspicuous stratification lines of lighter color. The formation is of two prevailing types—a hard rock and a softer one. It produces a lime which has but few equals in the United States.[2]

In early days lime-making in the Rockland district was conducted on a small scale according to the prevailing methods of home manufacturing. Each Yankee farm proprietor opened up a little quarry on his property, built a small kiln of beehive type and placed alternating layers of wood and limestone therein and, after three days' burning, tore down his kiln and took out the lime. The product was next barreled for shipment, the barrels (called "casks" in this connection) being made in local Yankee homes. Coasting schooners then carried the casks to the various ports along the coast.

[2] Analysis made by the Rockland and Rockport Lime Corp., June 27, 1929:

	Hard Rock Magnesia	*Soft Rock High Calcium*
Loss on ignition	1.05	.72
Silica plus insolubles.	3.49	1.16
Iron plus alumina...	1.45	1.05
Calcium oxide.....	83.28	96.40
Magnesium oxide...	10.16	.67
	100.00	100.00

IMPORTATION OF FUEL

The local supply of wood for limestone burning was soon exhausted and new sources of fuel had to be sought. Nova Scotia, being nearby and possessing vast timber resources, now began to contribute to the industry. In those days it was no uncommon sight to see in Rockland harbor as many as fifty to one hundred two-masted wood-carrying schooners of the Canadian "bluenoses." So great was the number of vessels entering Rockland that she claimed to be the third port of entry of the United States. The importation of wood was the first forward step in the evolution of the lime industry of the Rockland region.

Along with the importation of the wood came another step in the industry in its transformation from the home type to the factory type. No longer was the limestone burned near the individual quarries. At this time kilns of a much larger size were constructed on the water front. The new location compelled the farmer to haul the limerock from the quarry to the kilns and along with this change sprang up the business of teaming, thus adding two more changes in the specialization of the evolving industry. The farm, as before, furnished the limerock and, in addition, the means of transportation, but the burning of limestone had passed into other hands. The farmer-owners of limestone quarries found themselves getting into an ever-enlarging business with a growing force of laborers under their control, and a largely increased equipment of wagons and horses. This system continued in effect for many years, much to the detriment of the city streets, especially in springtime.

CHANGE FROM NATIVE TO FOREIGN LABOR

About 1890, in the course of the evolution of the industry, came the importation of labor. Hitherto, the work had been done by the native New England stock, but now the heavier jobs began to be performed by foreigners. People are still living

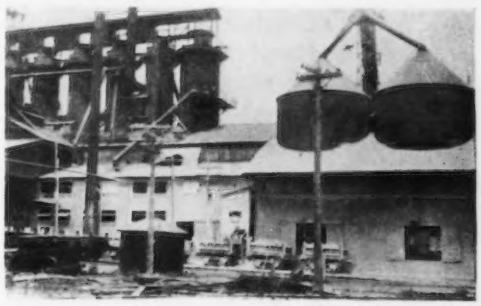

FIGURE 2.—Kilns at left. Waste being discharged into cars in foreground. Device for charging kiln is not shown in this picture.

in Rockland who can remember the first influx of foreign labor. The earliest to come were the Finns and Swedes, and with them the city saw the introduction of new ways and standards of living which profoundly affected local society.

The increase in production of lime under this new régime was accompanied by a need for more vessels. Three-masted lime-carrying schooners, with a capacity of 2,000 to 4,000 casks, were built in Rockland and its vicinity in greatly increased numbers. These boats, being expensive for those times, were a sort of partnership affair, men owning as little as one-sixty-fourth part of a vessel. With these boats carrying Rockland lime to ports as remote as New Orleans and Galveston, greater dangers were encountered. When water is mixed with quicklime, heat is generated and in the event of a loaded boat springing a leak, an explosion or conflagration is bound to

follow. The hazards of the business increased as the radius of ocean transportation grew and losses as well as profits were correspondingly greater.

As the market for Rockland lime increased, the method of transporting the rock by team from quarry to kiln became inadequate and a belt-line railroad was built passing from the principal quarries around the town in a complete circle[3] to the waterfront where the kilns and docks were located (see Fig. 1). The

FIGURE 3.—Old furnace with pile of waste shown in center of picture. Modern kilns may be seen at extreme left.

quarries which were not on the railroad found themselves at a decided disadvantage and, while a few continued the struggle for some time, one by one they have ceased production.[4] Not only were the quarries abandoned but, in many cases, the farms also, since the owners had been regarding agriculture as a side line for many years and were unable to return to it as a sole means of support. The families moved into town, more or less abandoning the farms or possibly renting them, farming became decadent and the way was opened for the later purchase of property by others. The lessening of the number of producing quarries accelerated the consolidation of the lime industry and the savings in costs effected by the railroad tended to increase the output of lime.

The time was now ripe for the consolidation of the industry under a single management. This change came from the outside rather than from the inside. A large corporation was formed in 1900 by Boston capitalists under the name of the Rockland and Rockport Lime Company (now the Rockland and Rockport Lime Corporation). One by one, the individual operators passed out of the picture until this company became the sole producer of lime in Rockland. It was in a position to make lime more cheaply through control of the entire process from the quarry to the casks of lime at the dock. This company took further steps to lessen the cost of

[3] Later, a short stretch of trestle work along the shore was torn down.

[4] In June, 1929, there was only one quarry not on the belt line railroad producing limestone. The kiln is located in Thomaston, although the quarry is in Rockland. The use of the automobile truck has been introduced within a few months to transport the rock to the kiln in which wood is burned to produce a higher grade of lime.

production. Among these was the building of larger and improved kilns, the greater use of machinery to do the work at the kilns and docks, and the purchase of steel barges of 16,000-cask capacity for the carrying of lime to the Boston and New York markets. The modern type of kiln is a towering steel structure over a hundred feet in height (Fig. 2) and so constructed and operated as to permit of continuous charging and drawing off of the lime, much as in the operation of a blast furnace. Side by side with these new and nearly self-operating kilns stand some old rectangular stone kilns as mute reminders of other days (Fig. 3). The mortar between the rocks has been pecked away by numerous birds who make their homes there, showing how completely the old days have gone.

The history of the Rockland lime industry has been a series of changes from the primitive stage of home manufacturing with its numerous small centers to the factory system, centralized in operation and doing a great part of its work through the use of steam and electricity instead of man power. As the industrial system developed the lime industry grew farther and farther away from those who originated it. We have already noted the coming of the Finns and Swedes as quarry workers. Workmen of other nationalities came to Rockland to perform the physical labor still required beyond that which could be done by machinery. Among these were Italians, Poles, and members of other European races.[5] As they came into the community which had been of almost pure New England stock, the foreign influences became more and more pronounced. These changes could be noticed in such ways as Sabbath observance, churches, amusements, and in foreign languages heard on the streets. Although not to the same degree as some of the industrial towns farther south in New England, Rockland has changed from an Anglo-Saxon community to a heterogeneous mixture of European peoples. The old New England stock did not take to factory labor and the importation of foreign labor was unavoidable. The change in Rockland, and likewise in New England, has been a double one —industrial, or from home manufacturing to the factory system; and social, or the introduction of the diverse foreign elements into the hitherto homogeneous communities.

[5] Population in Rockland:

	1860	*1870*	*1880*	*1890*	*1900*	*1910*	*1920*
Total	7,315	7,074	7,599	8,174	8,150	8,174	8,109
Foreign born...	320	323	514	610	821	642	

ASSIMILATION OF CERTAIN CLASSES OF FOREIGNERS

The geographer finds it of interest to note to what extent change and development is going on among the foreigners whom the lime industry has brought to Rockland. The Finns afford a good example for study. One of these, Eric H——, lives on his farm southwest of Rockland. He came to America from his native land at the age of nineteen to escape military duty in the czar's armies. Finland is a land of granite, and Eric was attracted to Rockland by opportunities for work in the quarries. He worked his way up until he became a foreman; then, when agriculture retrograded in the Rockland region and farm values went down, Eric became interested in land and bought a farm of 124 acres, with rather extensive buildings, for $1,600, half of which he was able to pay down. The remainder

FIGURE 4.—Finnish harrow. The Finns have retained many of their old habits and customs, but have adopted many of their adopted land.

was paid off within one year. He has now established a milk route and uses a cream separator made in Finland which he asserts is the best in the world. In connection with the milk business it was observed that he has three automobiles and three trucks. Everything about the dairy was spotlessly clean. A bottle of cold milk was served to visitors in place of the cup of coffee every Finn is supposed to give his guests. Eric's farm buildings (after living on the farm mentioned above he bought the one next to it on which there were no buildings) are of his own construction and carry out his own architectural ideas, being separated instead of in one connected chain which is the time-honored practice on Maine farms.

Looking over the farm machinery the visitor will see a Finnish harrow (Fig. 4), a type new to American eyes, but Eric is a good American even though he does prefer some Finnish machinery. He has become naturalized and has never gone back to Finland though he has been away nearly forty years. He is married—to a Finnish woman—and they have thirteen sturdy sons and daughters. One of the girls graduated from a business college and, after several years of office work, has married an American. Another of the girls is a graduate of the Farmington State Normal School and is now teaching.

The children of the Finlanders have become thoroughly Americanized. They go through the local high schools at Rockport and Rockland and frequently graduate at the head of their classes. The quarries do not attract the second and third generations, as witnessed by the fact that Eric's six sons are all working on the farm and milk route with him.[6]

Eric is the recognized leader of the Finns in Rockland and vicinity. He finances them (he has a large line of credit at the local bank) and as a result all but three of the farmers in Eric's neighborhood are Finlanders. He has prospered in the land of his adoption and America should be proud to claim him as her own. While Eric's case is perhaps outstanding, nevertheless it is more or less typical of certain classes of foreigners attracted to that vicinity by the lime industry.

METHODS OF TRANSPORTATION

In early days lime was transported almost exclusively by water. It is a recognized fact that transportation by water is cheaper than that by land. However, other factors may enter in, which will make rail transportation more desirable even though slightly more expensive. When the lime was taken by water to Boston, the dealers in that city were located along the water front and took a whole boat-load at a

[6] Van Cleef in his book, *Finland—The Republic Farthest North*, supports many of the facts mentioned above with relation to the Finns.

time. As rents and taxes became higher in Boston, the dealers tended to shift their yards to points on railroad tracks near the outskirts of the city. This, plus the fact that lime is a perishable product, caused a change in the method of transportation to the Boston market so that the wholesaler, instead of taking a whole boatload as was formerly the case, may now order any amount he desires and receive it within two days by regular rail freight service. But, while the railroad has captured much of the lime-carrying business as far as Boston is concerned, transportation to the more important New York market is still by water. For this purpose steel barges belonging to the Rockland and Rockport Lime Corporation are used, the towing being done by sea-going tugs. Practically all the building lime is sent to Boston and New York, shipment being made to a great extent in bulk which saves the costs of casks and something on the handling. All of the lime which is sent to paper mills in various parts of Maine is handled in bulk also.

FIGURE 5.—View taken at one end of narrow, deep gash. Booms at left raise limerock which is placed on cars to be taken to kiln. The loaded drag is shown.

The market for lime is seasonal in some cases and constant in others. In the building trades and paper pulp mills the demand is fairly steady the year around. In early spring there is a strong demand for lime for farm fertilizer. A little later in the spring much lime is shipped for use in the spraying mixtures in the orchards. Both quicklime (CaO) and hydrated lime are made for the market. Hydrated lime is safer to handle, does not easily deteriorate, as is the case with quicklime, and the hydration is also a necessity in some uses as in the case of treating the soil with lime or the spraying of fruit trees. While in the early days quicklime was the only product put out by the producers, now, due to brand names, to various sizes of packages for the retail trade and limes for various uses, as many as thirty to forty types are sold. The cask has also undergone a change, the staves being grooved now to preserve the lime by preventing moisture from coming in contact with it.

The later developments in fuels for lime burning in Rockland are of interest. The use of coal for fuel in the kilns has long since displaced the Nova Scotia wood. When barge service to New York was started, it was obviously better to load the barges with coal for the return trip

than to have them come back empty. Finally, in the testing of fuels it has been found best to generate gas from the coal and burn that in the preparation of the lime instead of using the coal directly.

The latest step in the commercial use of Rockland limestone is the making of cement. We have seen that two kinds of stone are found in the Rockland structure, soft and hard limestone. These occur in close proximity in each quarry. Hitherto the rock less valuable for lime has either been given away to the municipality for highway construction or broken up and sent to a Massachusetts blast furnace. Now a new company has entered the field with the idea of using the best stone for lime and the remainder for cement, and so doing away with much of the waste which up to this time had been deemed unavoidable. This company has introduced an innovation in regard to transportation of materials preceding the burning of the rock. By constructing the mills and kilns at the edge of the quarries it is possible to do away with the conveyance of limerock by rail and carry the material in cars on a long inclined track from the bottom of the pits direct to the kiln or mill. They, of course, lose whatever advantage there may be in being situated at the water side.

The visitor to the quarries at Rockland finds them most impressive to the sight. They form long, open gashes with vertical sides, and the men working in the bottom are so far down as to appear insignificant in size (Fig. 5). They are among the deepest quarries in the country, the largest one extending to about 320 feet below the surface of the ground. Long booms swing out over the terrifying chasm and let down drags which are filled with rock by the quarrymen and raised to the surface (Fig. 6) on signal to the hoisting engineer.

FIGURE 6.—Drag being raised to surface.

Occasionally, men may be seen taking the thrilling ride down or up on one of these drags, as it is impossible to reach the bottom of the pits by any other means. The pits which are not being worked are full of greenish or bluish water to within fifty feet of the top. As the observer notes the immense size of these quarries, he may realize something of the enormous amount of lime which Rockland has furnished to the working world and is still furnishing.

It seems that industry always brings something physically or

aesthetically objectionable in its wake, and the Rockland lime industry is no exception. The rutted streets of the hauling days are no longer found. The dust and pall of smoke when methods were less efficient have largely disappeared, but the awful-looking chasms of the worked-out quarries and those still in production are in the suburbs of Rockland to stay, since it is impractical to attempt to fill many of them.

From the foregoing, something may be seen of the different steps through which this one industry has passed. What is true of this one is typical of scores of others in New England towns and cities. Many of them, like Rockland, are more or less dependent on a single industry. In some cases competition, and in others substitutes, have caused the original industries to decline or become defunct. Gypsum and cement are taking the place of lime in some places today. What will happen to Rockland if the lime production declines, since that is the chief industry in the town? Many New England towns have had to face this same problem. Some have survived and some have had to give up the struggle. It is a question which cannot be answered offhand as there are too many factors involved and the ultimate test will be whether Rockland, like New England as a whole, has the adaptability to maintain her position in a changing industry against newer and possibly more logical industrial centers.[7]

[7] In July, 1930, the cement plant mentioned above was running night and day turning out cement for new highways for the State Highway Department. Cement illustrates the principle that bulky inexpensive articles will be made as near as possible to the place of consumption because they cannot stand heavy transportation charges. It may be that this new industry will prove a boon to Rockland if the lime industry does decline. Incidently, this has happened to many towns throughout New England; a new industry comes in, either utilizing the equipment of one which has become defunct or using the labor of a declining manufacturing town. Thus New England has survived, and will probably continue to survive, the rise and fall of industry.

MOUNTAIN TOPS AND LOWLANDS OF COLOMBIA

Albert C. Smith

Assistant Curator, New York Botanical Gardens

THE harbor of Cartagena spreads a beautiful vista before an approaching vessel. The low hills which encircle it are decked with verdure to the water's edge. In the distance the hills mount in long and sloping curves. As the vessel steams through the narrow entrance, "La Boca Chica," it is frowned upon by a series of forts which once held the harbor impregnable. Across the clear and azure water the city appears, white and inviting.

Indeed Cartagena deserves its old title of "The Queen of the Indies." Navies could be sheltered in its vast landlocked harbor. Only two channels connect this expanse of smooth water with the sea. Of these, only "La Boca Chica" is navigable; the other, "La Boca Grande," was filled with stone during the days of pirate domination.

The early history of Cartagena is the story of battles and sieges, of plunderings and revolutions. It was once the most prominent city on the Spanish Main, due to its ideal position and harbor. Its rapid accumulation of commercial wealth made it the goal of French and English pirates who infested the region. So often was it captured and plundered that the inhabitants built sturdy walls around it, and eventually blocked "La Boca Grande." After this maneuver Cartagena was less open to enemies.

In the last century Cartagena has been the seat of many political agitations and revolutions, but alas! —while different factors quarrelled to retain possession of it, Cartagena rapidly lost commercial importance. In recent times it has been succeeded as Colombia's chief port by its sister city, Barranquilla. Only in the last few years has Cartagena realized its situation and endeavored to regain its lost prestige.

But "The Queen of the Indies" has changed since the days when La-Fitte coveted it. To be sure, the old forts still stand at the sides of "La Boca Chica," but their crumbled sides and fallen towers are silent tokens of past power. The staunch walls still encircle the "old city," but their grass-grown slopes no longer challenge foreign fleets.

Within the walls is the business section; narrow, twisting streets cross and re-cross, flanked by stores, offices, and occasionally by a grim-fronted dwelling. The stores are innocent of that American device, the show window, but their stout open doors disclose as well-stocked shelves as many Northern cities can boast. The business houses, too, are surprisingly modern, and one is agreeably surprised to find within them cool and pleasant patios, bordered by offices which are the last word in efficiency, with typewriters, electric fans, and water coolers.

The one feature which every visitor to Cartagena remembers is the market. This is essentially an open barn-like building on the edge of the harbor, but the greater part of transactions take place in the open, on a quay which lies adjoining. To this

FIGURE 1.—Building a bamboo houseboat by the riverside.

come the sailing boats and the dug-out canoes of the coast negroes, who bring their wares from island villages and tiny settlements of the coastal marshes. In the early morning they come, and after a great deal of squabbling over the choice places, each boat is tied to the quay and the work of selling begins.

Meat, fish, charcoal, cocoanuts, yuca, and fruits are exposed to the eyes of the buyer, and too often, alas, to a horde of flies as well. Servants, housewives, and hotel boys crowd to the edges to get the choicest bargains, and the bargaining becomes shrill and furious as neither buyer nor seller will yield a "centavo." On the quay are numerous booths where ices and cold fruit drinks are offered the hot and weary marketers. Taxi drivers and coach drivers jostle those who appear more prosperous, idlers chat and joke, children play underfoot in naked comfort, and, altogether, the scene is one of busy confusion.

But, as the sun's heat becomes more intense, the activity wanes. Shoppers wander home with their purchases, while the salesmen cover their boats with canvas and retire for a "siesta." The young seek peace in the cool waters of the harbor. Fortunate is the boatman who has sold his load before noon, for his is a long "siesta," and he is untroubled until the cool approach of evening makes feasible a return sail to his hut.

Recently "The Queen of the Indies" has been making a gallant bid to regain power. A surprising amount of commerce creeps through the tortuous channel of "La Boca Chica." On its land side, Cartagena is connected with the main artery of Colombia, the Magdalena River, by a modern railway, along which traffic with the interior progresses.

But the railroad is a recent development, and, long before its inception, Cartagena had an outlet to

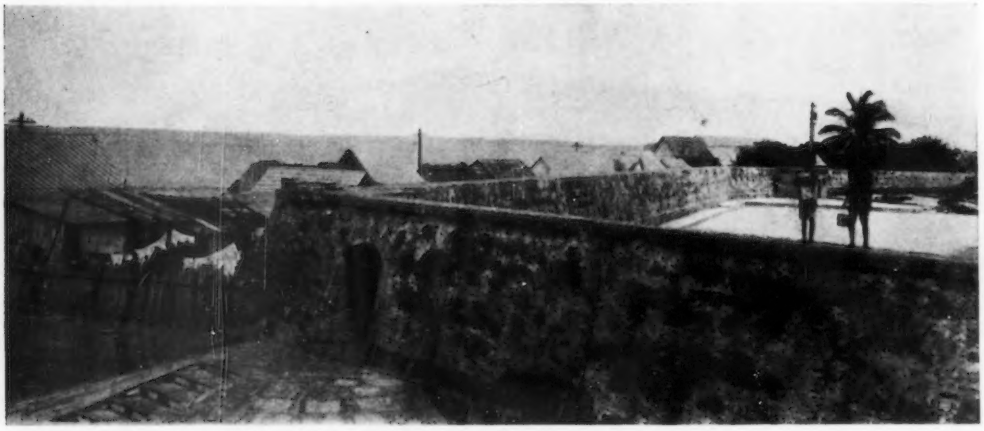

FIGURE 2.—A corner of Cartagena's famous and much-exaggerated walls.

the river. A natural canal, known as the "Dique," connects the waters of the harbor with those of the Magdalena. Constant dredging is necessary to make transportation through the canal feasible, and, of course, the railroad is more popular with travelers and commercial houses.

Where the "Dique" enters the Magdalena is the town of Calamar—a typical river settlement. It is a busy place, receiving the river traffic from both directions and that of Cartagena in addition. The activity of Calamar, as of other river towns, centers along its waterfront. The broad, swift river flows past a low embankment here, and is deep enough to allow boats to tie directly to the shore.

The top of the embankment is a pleasant street, in truth, the "Fifth Avenue" of Calamar, except that on one side is the flowing Magdalena. On the other side are the town's shops—hat shops, shoe shops, food shops—all kinds of shops where you can stock up for a long river trip.

FIGURE 3.—The city of Cartagena from the summit of a hill in the suburbs.

It does not pay to be impatient when one is waiting for a Magdalena

boat. One will always wait hours, often days, and occasionally, in times of low water, weeks. The boat, when it does come, is not much to look at, but it is far superior to what acquaintances have led people to expect. The reputation which Magdalena steamers are given is hard to understand, for unless one is a very finicky traveler, the river trip is one of the most fascinating in Colombia. Mosquitoes are a drawback to comfort, but usually a pleasant breeze keeps the deck free of them.

FIGURE 4.—Cartagena's outdoor market during the morning hours.

The boats themselves are a trifle ancient; they are stern-wheelers, of a type well known to old Mississippi travelers; but the accommodations and food are good, the scenery varied and shifting, and one's fellow-passengers usually "sympatico," so that the trip often passes too quickly.

The subsequent towns on an up-river trip are reproductions of Calamar—some are smaller, some larger, some dirtier, but all have a main street on the waterfront and huts of the townspeople in back. During the months of October and November, the river is at its highest, and landing is an easy matter. But at other seasons water is scarce, and often boats must discontinue their schedules for long periods, lying idly on hidden bars.

Aside from the towns, the river, for the most part, is bordered by solid jungle. Crocodiles sun themselves on exposed sand spits, and sometimes in the dusk the distant roar of howler monkeys is heard. Occasional clearings interrupt the monotony. Here two or three straw huts huddle, while the jungle overruns their very backyards. In the flood season these huts are practically islands; the river even creeps inside, and from the boat can be seen inhabitants who live in knee-deep mud-water. Often they wave cheerfully, seeming to enjoy their watery isolation.

Sometimes the boat passes solitary banana plantations, sometimes oil stations or huge woodpiles for the use of old wood-burning steamers. But the woodpiles are becoming less frequent, for the recent oil development in Colombia has given an impetus to the use of oil-burning boats.

FIGURE 5.—Street scene in Cartagena.

Many of the river towns owe their existence to the present oil boom. Such places are Puerto Wilches and Barranca Bermeja, although the former owes much of its growth to the development of Bucaramanga, an inland city. The only means of transport to and from Bucaramanga is through Puerto Wilches. On this spot but a few years ago were several mean huts; now there are dozens of houses and stores, a good hotel, and a terminal for an interior railroad.

Visitors to Bucaramanga are given a choice of two methods of travel. One is by airplane; the other, by mule. There is no half-way, for the railroad runs inland only a short distance. Airplane travel is maintained in daily and fairly dependable service, but it is still very expensive. Many times a traveler must patiently await his turn, and even then he can carry no baggage. Therefore, mule-back is the predominant method of transportation.

It is wise to begin the journey early in the morning, for ahead lie fourteen "leagues" (a league is that ephemeral distance which Colombians consider one hour of steady traveling). To secure riding mules is not such an easy task as it sounds, for all are engaged in cargo carrying, a more profitable trade. The traveler is quite at the mercy of the suave Spanish-negroes who dominate the region, and can do little but accede to their exorbitant demands. Finally mules are secured, and a boy to guide and to take care of the cargo is also found. So the procession starts. Soon the huts of the village are left behind, and the road leads through unbroken jungle. "Road" is a very general term, for often the mules wallow through streams, sink in mud which coats their flanks, or climb wearily over bare rock ledges. The lowland gives way to mountain slopes and a gracious breeze supplants the hot breathlessness.

The trip to Bucaramanga is usually made in two days. Traveling becomes more difficult as the road increases its dips and curves. It leads through a rough, broken country, marked with huge trees and tangled undergrowth. One is very apt to become discouraged and wonder what kind of city can lie in this wilderness. About the middle of the second day the highest point is reached, an open ridge from which an impressive view to the east is exposed. A first glance at the hills and valleys below discloses no hope of a speedy end of the journey, but the keen eyes of the guide find a cluster of white spots in the distance. "It is Bucaramanga," he says.

Then the traveler feels much en-

couraged, perhaps unduly so, for a long six hours lie between him and his destination—six hours which must be spent coaxing and spurring a tired mule over steep dangerous roads. It is dusk when the traveler rides through the outskirts of Bucaramanga. All that can be seen are the narrow, straight streets, sparsely lighted by electric lamps, and the plain walls of quiet dwellings. A pedestrian guides his clattering mule over the cobblestones to a hotel. Here an agreeable surprise awaits, for the hotel is a cool and pleasant building, with a most genial "Señora." Everything is done for the traveler's convenience; one need only rest and partake of supper before seeking sleep in one of the large open rooms.

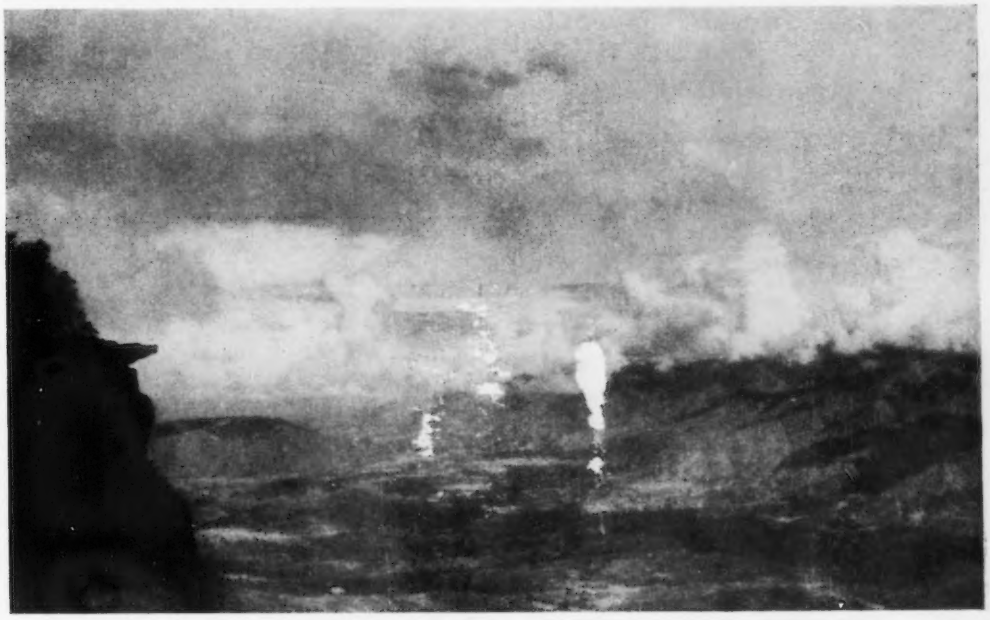

FIGURE 6.—A view of the valley in which Bucaramanga lies.

In the morning Bucaramanga presents a different aspect. The city is situated on a broad plain raised above the level of the valley which is formed by the Río Lebrija. It is a growing city, with a present population of about 30,000. Its streets are straight and paved, dotted with private automobiles and taxis. Along the "Calle Real" (Main Street) are shops of all description, all of them extremely well equipped. Residences and public buildings are modern to the last degree, with electricity, pianos, victrolas, and all luxuries.

This is all the more astonishing when it is realized that every piece of machinery, every plumbing accessory, every piano and luxury is carried in pieces on a mule's back over the wretched road from Puerto Wilches! To carry a single touring car over this sixty-mile stretch twelve mules are necessary, and the body of the car must be carried by hand by peons in slow stages!

Yet the interior cities of Colombia, as represented by Bucaramanga, are superior in every way to the coast towns. The state of their progress

on every hand astonishes. The natives of this region are a mixture of Spanish and Indian; they are in the main very intelligent, and courtesy is extended on every side.

To the east of the valley in which lies Bucaramanga can be seen the foothills of a vast mountain range, the backbone of the Eastern Cordillera. The distant peaks which appear through the haze on exceptionally clear days are the high points of the Páramo of Santurbán, the "altissimo" of eastern Colombia. The páramos of Colombia form a distinct geographical feature of the country. They are the tops of mountains, usually more or less flat rolling plains, windswept and inhospitable. At places Santurbán rises above 15,000 feet. Its edges are roughened by projecting spurs and shoulders, each of which is locally known by another name. The main páramo is an important feature of the Eastern Cordillera. Economically, it forms a barrier which cuts off one entire state, Norte de Santander, from the rest of Colombia. All the commerce of this rich region passes through western Venezuela to the sea.

A traveler can only gain a correct impression of the páramo people by spending some time in one of their huts. On such a "rancho" the author stayed for several days. The head of the household was a good-natured Spaniard named Pedro Gonzales, whose hospitality will long be remembered. His house is a two-roomed, whitewashed, earthern hut, placed on the very brink of the páramo, whence it commands an unexcelled view. Nearby is another hut which serves as a kitchen as well as a living and sleeping room for the younger members of the family.

FIGURE 7.—A caravan crossing the Páramo of Santurbán at an altitude of 15,000 feet.

In the evening all gather around the open fire in the kitchen, and supper takes place simultaneously with the discussions of the elders and the dissensions of the youngsters. Pedro Gonzales' wife boasts eleven children, and in addition there are aunts and brothers and several "hired men." The entire group around the fire numbers well over twenty, and the room is crowded and airless. Once or twice during the evening the door opens to admit a "neighbor" who is passing with a caravan and seeks a place to sup and sleep. The kitchens of these páramo homes are always open to passers-by. The

women perpetually peel potatoes in preparation for the next day, and a huge pot of them boils over the fire. The only other cooking is the baking of a hard, flat corn bread, which is tough and unpalatable. These are the staple foods of the mountaineers, with occasional meat and soup.

Animated conversation lasts long into the evening, due to the presence of the "Americano." Eventually, the children, one by one, creep off to a corner of the hut to sleep among rags and skins—an arrangement which would breed disease in a warmer climate, but which seems to breed only healthy faces and perpetual hunger here. However, the lives of the mountain people are far from happy; for the grown-ups it is a never-won struggle against poverty, for the children a dull existence in which play is prohibited by the cold and the necessity for work as soon as they are able.

Below the eastern rim of Santurbán lies Pamplona, five days distant from Bucaramanga across the massive range. Pamplona is also an astonishing town, for it is just as isolated as Bucaramanga from the outside world, yet, like its sister city across the páramo, it has all the conveniences which a mule can carry. But alas, Pamplona has none of the climatic charms of Bucaramanga. It has a higher altitude and is correspondingly colder, with the driving fog which sweeps down from the páramos. The nearby hills are sharp and barren, and a less hospitable place for a city could scarcely have been found.

The inhabitants here show a very high percentage of pure Spanish blood, being of old and conservative families. Their hospitality is unbounded, and, were it not for its

FIGURE 8.—A caravan loaded with coffee leaves for a trip over the mountain roads.

climate, Pamplona would indeed be the loveliest of Colombian cities. It is one of the most important places in its department, Norte de Santander, being second only to Cúcuta. To Pamplona come all the products of the rich region south of it.

Transportation is the most serious problem in Colombia. The roads which connect small towns with the outside world are wretched at best. During the rainy season travel is absolutely at a standstill; sometimes a road is unusable for two or three consecutive months. Practically no work of repairing is ever done, but the mules must wear their own trails and keep them passable by constant use.

In some sections of the country an effort towards improvement is being made. Between Pamplona and Cúcuta a wagon road is being built, but this is truly one of the

poorest pieces of engineering imaginable. No cement is used, but the huge rocks which form the road's basis are thrown together and covered by sand and dirt. Naturally, the first heavy rain washes away the labor of months, and the slow process begins again. What Colombia needs more than anything else is friendly help in this direction, to give the towns some stable connection with the cities, and the cities communication with each other.

Most of the distance from Pamplona to Cúcuta must be covered on a mule, but at the tiny settlement of La Esmeralda there is a railroad which leads into Cúcuta. Concerning railroad structure in Colombia much might also be written, for the same backwardness in engineering methods exists. La Esmeralda is at the base of the mountains; behind arises the huge bulk of the Eastern Cordillera, ahead lie the gentle hills of the lowlands. Up to this point the railroad has progressed rapidly, but here the forbidding mountain wall holds progress at a standstill.

Having reached the railroad, the rest of the way to Cúcuta is comparative luxury. The train rolls steadily down the gradual slope to the city, where a real stone station exists. We have no sooner become accustomed to this magnificence than we are confronted by another—a real street car awaits outside. It consists of two dilapidated coaches drawn by an old Baldwin locomotive, but nevertheless it makes sturdy speed through the streets.

FIGURE 9.—A mountain family enjoys the pictures in an old *New York Times*.

Cúcuta is the capital of its Department, Norte de Santander. It is a new city, built on the site of one which an earthquake destroyed fifty years ago. Its climate is ideal; although it has a low elevation above the sea, mosquitoes are rare, and its weather is always clear and refresh-

ing. After a long stay in the frigid mountain regions, Cúcuta is luxurious.

It is often considered the most beautiful city in Colombia, and among those the writer has seen, it assuredly deserves the title. Its streets are broad and paved, with sidewalks where several pedestrians can walk abreast (a very unusual feature in Latin America). The public buildings are many, and the "Palace de Gobernaçion" is a building which few American cities can surpass in beauty and efficient arrangement. Cúcuta has several excellent hotels which rival each other to make the visitor comfortable.

In addition to these charms, Cúcuta is one of the easiest of inland cities to approach. From it a railroad leads down to a navigable river, the Catatumbo. Here a weekly boat carries passengers across Lake Maracaibo to the city of that name, and, once in Maracaibo, the traveler can reach any port by ocean-going steamers.

Cúcuta is the gateway to Eastern Colombia. It controls an immense and rich region which is cut off from the rest of Colombia by the Andean wall. But, if friendly relations with Venezuela continue, this section will develop rapidly. As trade and travel routes are improved, Cúcuta will receive more business and more visitors, as is the due of its ideal location and its unlimited natural resources.

GLACIAL TOPOGRAPHY AND AGRICULTURE IN CENTRAL MASSACHUSETTS[1]

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THIS paper is the result of horticultural studies made in the town of Stow, Massachussetts, in the summers of 1928 and 1929. The region is more or less typical of the drumlin area of the middle eastern part of the State. The reaction of agriculture to physiographic background is about as marked as will be found in any part of the region. This is most clearly exemplified in the neighborhood of Birch Hill, about one mile south of Stow Center and is typified by the farm of "Fruit Acres" and the adjacent lands which were used as a center of operation and observation. In a study of this area, the all-important factor is glaciation with its resultant land forms, most of which are here depositional, rather than erosional in origin.

TOPOGRAPHY

The glacial features of this section play an important rôle in the topography of the region.

GLACIAL FEATURES

The most important topographic feature is the drumlins which constitute the majority of the hills of this region, typified by their shape and lack of rock outcrops. Excavations in these hills show typical glacial boulder-clays and gravels. Marble Hill, one and a half miles northwest of Stow Center, is a marked exception to the drumlin type, since here are to be found several outcrops of granite. This hill is the highest in the area, 481 feet, most of the others being less than 400 feet above sea level. Marble Hill is distinguished from the others by its shape as well as by its height and rock core. It is a true "drumloidal" hill, having the gentle stoss slope, which would be produced if the eroding ice were forced to rise gradually in passing over a resistant obstacle consisting of consolidated materials, and the steep, lee slope which would be produced by plucking on the "down-stream" side of the obstruction. The drumlins, on the other hand, have steeper northern than southern slopes. It seems highly probable that these differences in slope may be attributed to the fact that ice could break through unconsolidated material quite readily and would tend to drag out the loose débris behind those parts of the original obstacle which remained in place. Plucking would be impossible because the material was unconsolidated. Drumlins might be formed in the manner described if a readvance of the ice produced overriding and reworking of an old moraine. In other words, gentle "upstream" slopes could occur only when the material being overridden was of sufficient resistance to bear the entire weight of the ice and thus force it to rise somewhat in passing over the obstacle. Steep "down-

[1] The author wishes to acknowledge the assistance of Mr. H. A. Priest in obtaining field data, and the helpful criticism of the contents of this paper by Professor Bradford Willard and Mr. Duncan Stewart, Jr.

stream" slopes could occur only through plucking of large blocks. Erosion of unconsolidated materials by ice could produce neither effect.

As may be seen from the map (Fig. 1) many of the hills of the region trend northeast-southwest, but the main core of Marble Hill trends northwest-southeast, as do several smaller hills in line with its main axis

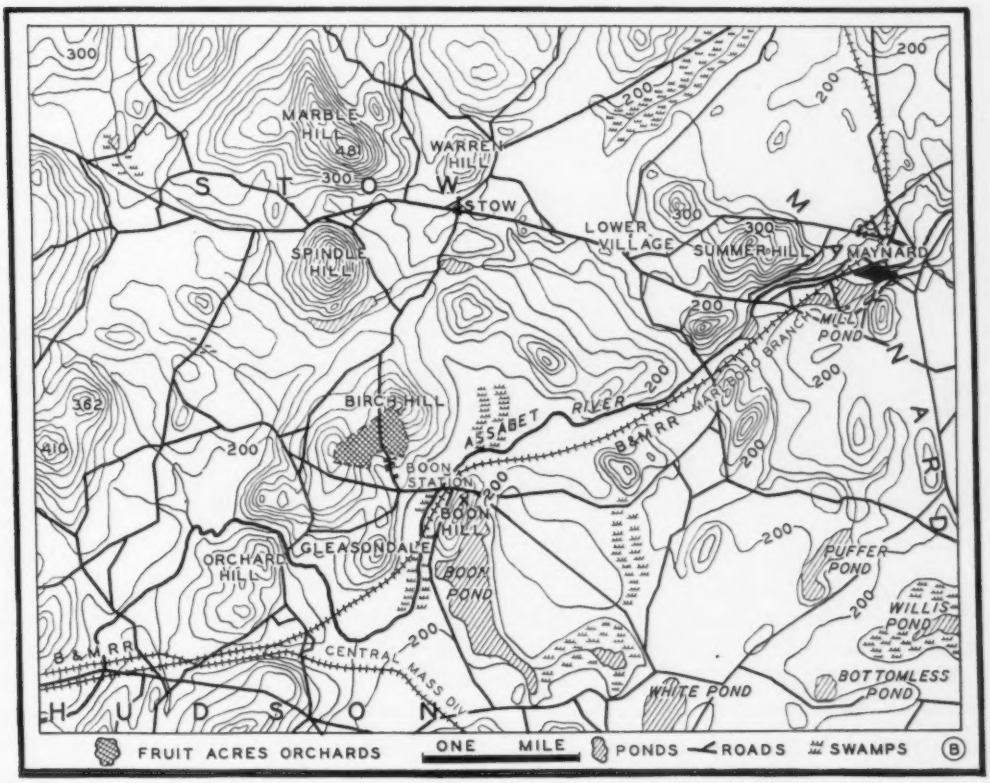

FIGURE 1.—Topographic map of the vicinity of Stow, Massachusetts. (From U. S. Topographic Maps.)

The main lobe of ice-shaped Summer Hill, in Maynard, and the southern portion of Birch Hill without being deflected from its northeast-southwest direction. Boon Hill, just south of Birch Hill, trends with the main lobe and nearly at right angles to Birch Hill, indicating that it was between these two hills that the tongue of ice, deflected eastward to the southeast. Apparently this anomaly is due to the fact that Marble Hill was of sufficient height and resistance to deflect eastward a tongue of ice which caused the orientation of the small hills. Probably some of the ice overrode Marble Hill, thus shaping Spindle Hill and most of Birch Hill, lying to the south. by Marble Hill, flowed into the main lobe and was absorbed by it.

GLACIO-FLUVIATILE FEATURES

The Assabet Outlet of glacial Lake Nashua fringes the southern sides of Birch Hill, Summer Hill, and other drumlins similarly situated. Apparently the sediments deposited in the

outlet, or in the lake into which it flowed in this region, were built up around the hills to a considerable height above their bases. These deposits have been much eroded by recent stream action, leaving local terraces. Where the present stream has swung close to the hills, steepened slopes have been produced.

Apparently the Assabet Outlet entered glacial Lake Sudbury just east of the town of Hudson in the southwest corner of the accompanying map (Fig. 1). Gradually it built a delta which filled the lake as high as the 220 foot contour and as far northeastward as Boon Hill for, in a large sand pit just west of the crossroads south of "Fruit Acres," the bedding of the sand and gravel dips steeply eastward, as would be expected in a delta deposit built from west to east. In a large pit about a half mile northeast of the northern tip of Boon Hill, the beds lie almost horizontally as if deposited in quieter water. The eastern limit of the delta, therefore, lies somewhere between these two pits. The delta and the quiet-water deposits comprise the sand-plain which extends from the line of drumlins southward to Nobscot Hill in Framingham and eastward beyond Concord.

While the lake was in existence, the present hills rose as islands. As the lake water receded, the stream carried its materials farther eastward before depositing, thus accounting for the presence of coarse, stream-laid sediments on top of finer, quiet-water deposits. Apparently this later series built out along the northern border of the old lake, giving rise to steeply-dipping beds farther eastward to the north of Boon Hill than to the south of it around Boon Pond. The stream continued to build its delta farther out into the lake until its load was decreased, possibly through settling in the basin of Lake Wachuset to the west, when it began to intrench itself in the deltaic deposits in the old lake bed. This channel was gradually deepened and extended eastward and became the present course of Assabet River.

FIGURE 2.—Assabet Outlet looking southwest from the north side of Boon Hill.

Assabet River is a misfit stream. The flood-plain is sometimes a quarter mile in width, while the stream, as between Gleasondale and the outlet of Boon Pond, may be ten feet wide, rather swift, and bordered by

FIGURE 3.—Southern slope of Birch Hill from Boon Hill, showing Assabet River, lowland, and orchards of "Fruit Acres."

marshland. In some parts of its course, due to flat stretches, the river widens to the full extent of its flood-plain, but is so sluggish that, except in flood time, the current is scarcely noticeable. Throughout most of its course, the river is bordered by terraces which range from twenty to thirty feet in height. Where the stream has been constricted by confining ledges, it has cut down to bedrock, producing rapids. Where it has been able to cut laterally unhindered above such rapids, the bed is wider and the water deeper and quieter. The gorge of the stream through the center of Maynard is a good illustration of the narrow portions, and examples of the wider reaches occur between Maynard and Boon Station on the Fitchburg Division of the Boston and Maine Railroad.

LOCAL TOPOGRAPHY AND AGRICULTURE

The topography is chiefly of importance in its relation to agriculture.

SAND-PLAIN

Throughout most of the area of the sand-plain, especially around Boon Pond, the soil is so sandy that almost the only vegetation that it will support is a thin growth of scrub pine and oak except in the immediate vicinity of the water. Farther east, in Sudbury Meadows and Concord Meadows, occur extensive areas of rich silt-loam deposits which support large truck farms. It is possible that these latter areas were never above lake level during the periods of deposition so that their sediments were fine, while those nearer the borders of the old lake are coarser, probably deposited either in the stream beds proper or as deltas and beaches along the margins of the lake.

DRUMLIN AREA

In the drumlin area are to be found many pockets of alluvial deposits of varying richness, and it is here that much of the general farming is carried on. They support excellent hay and garden crops for several seasons

FIGURE 4.—Top of Birch Hill, looking south over "Fruit Acres" across the Assabet Outlet. Young trees show in the foreground on the crown of the hill, and also on the edge of the flat at the foot of the hill. Older trees occupy the slope of the hill but are hidden from view by the shoulder.

without heavy fertilizing, although frequent liming is advantageous. The slight elevations in the area are more easily cultivated because they are drier and firmer than the lowest parts.

It is the hills themselves which play the greatest part in the agricultural development. The soil is chiefly a stony loam, potentially rich in plant foods, well-drained, and yet the water-table is sufficiently high so that trees thrive if properly tended. For this reason, we find either orchards, pastures, or woodlands on the uplands proper, depending upon slope, exposure, and soil. The southern slope of Marble Hill, insofar as noted, is the only southern slope devoted to woodland. Here the slope is too steep for cultivation and only forests can withstand erosion.

"FRUIT ACRES"

Having discussed the area in general, let us now consider our type example, "Fruit Acres." The accompanying photograph (Fig. 3), taken from the point X in Figure 1 on top of Boon Hill and looking north toward the crest of Birch Hill, shows the southern slope of the latter, with most of the orchards of the farm and also some of the adjacent gardens and woodlands. The river, with its narrow border of marsh is nearly hidden by the shoulder of Boon Hill in the foreground, but may be seen between the trees in the center. Across the middle distance the wide lowland, which is possibly three feet above mean stream level at the river, rises gently toward Birch Hill. The lowland is devoted to hay and garden crops with a few apple trees scattered here and there. As the surface rises slightly and drainage improves, the orchards begin, continuing upward to within a few feet of the crest of the hill as a solid block of trees of varying ages. These orchards extend in an almost unbroken mass across the picture and also beyond to the left. The orchards of "Fruit Acres" are shown by broken lines on Figure 1.

The greatest advantage of the southerly and westerly slopes of the hill over the northern and eastern slopes lies in their exposure. The greater insolation of the former slopes

permits the trees to start to grow earlier here than on the latter, consequently the fruit in these orchards matures before that of other sections, thus permitting its marketing during the peak of prices, for it is the early fruit which yields the greatest profit. In 1929 the peak of production of Yellow Transparent apples from the Birch Hill orchards was reached nearly five days before the peak for other orchards whose owners also shipped to the Boston market. Consequently, the product of the Birch Hill orchards brought prices much higher than those obtained later in the season for the same variety, inasmuch as a start of a day or two is a distinct advantage because of the highly perishable nature of the fruit as well as the fact that they are the first apples of the season and so eagerly awaited by the restaurants.

FIGURE 5.—View from top of a tree half way up the hill, in the Horse Pasture, "Fruit Acres," showing the old Baldwin Orchard in the foreground, with the valley in the middle distance and Nobscot Hill in Framingham rising in the background.

The easterly slope of Birch Hill is very steep and still left to woodland. Whereas the northern slope is partly gentle, most of it is quite steep and is covered with a soil that contains so many boulders as to almost preclude profitable tillage. Its northern exposure has a disadvantage for orchards in that insolation is rather weak at critical seasons, as distinguished from the southern slope conditions. At present, it is used as a reserve pasture and is largely covered by scrub growth and brush.

DEVELOPMENT OF ORCHARDS

Until about 1900, the farms of the area were more or less independent units, each almost completely self-supporting as far as foodstuffs were concerned. The surplus crops were turned into manufactured articles and food luxuries by trading in the neighboring villages. This meant a greatly diversified type of agriculture, with dairying ranking high because of the ready market for milk in Boston. "Fruit Acres" was such a type of farm. Since 1900 there has been a gradual but steady swing toward a general policy of utilizing each type of land to its best advantage. Whereas once garden patches, hay fields, and orchards were located without regard to topography or soil, each crop is now almost always to be found in the places best adapted to it. Orchards are given first consideration as to location because apple-raising is steadily increasing in importance with all other types of agriculture taking minor positions.

When fruit-raising first assumed a commercial scale, the most favorable sections of each farm were set out. Thus at "Fruit Acres" we find the oldest orchards just above the buildings on the first rise of the hill, because here the surface slopes steeply toward the south, and yet is not steep enough to interfere seriously with cultivation. This orchard is far enough above the flats so that in early spring frost drainage is good

and the buds protected from damage because the cold air slides down the slope and toward the river without collecting in a thick enough layer to reach the trees. The soil is a stony loam, ideal for trees, and there is sufficient water within reach of the tree roots, due to seepage from the top of the hill. The soil is especially

FIGURE 6.—Foot of the north slope of Spindle Hill, showing the rocky pasture in the foreground. In the middle distance, orchards may be seen occupying the gradual southern slope of a small drumlin. The depression between is covered with scrub growth and swamp land.

well adapted to orchards; for the stony loam lasts longer than would a finer soil because it takes a considerable time for the tree roots entirely to break down the small cobbles, which are mostly granitic and so rich in plant foods. This means that, although the trees when young need considerable fertilizer, as they grow older they demand proportionately less than would be the case if the soil were finer and the food contained therein more easily digested. It is also easier to control tree growth by food adjustment in a coarse soil than in a fine soil.

As the market for the product of this region expanded and transportation facilities improved, further production and larger orchards appeared warranted. The orchards were expanded, first laterally along the hill near the same elevation, then in a parallel belt higher up the hill, and finally below the first belt onto the edges of the sandy deposits along the river terraces. The lowlands, or pockets, throughout the area have been rightly left until last because their soil is so wet and heavy that expensive drains must be installed if the trees are to thrive. Even with drains, young trees are liable to be drowned out in a wet season. Also, it is in these pockets, that the cold air collects as it drains down from the slopes in spring, causing heavier frost damage than in any other part.

SUMMARY AND CONCLUSIONS

The vicinity of the town of Stow, Massachusetts, is a good type example for the discussion of the relation of agriculture to glacial topography. The principal topographic features are the drumlins, the Assabet Outlet of glacial Lake Wachuset, and the sand-plain deposits of the basin of glacial Lake Sudbury.

Whereas formerly, the region was one of diversified agriculture, it is now rapidly becoming an apple-raising district of considerable importance. The change from farming to fruit-raising has been brought about largely by an increase in market demand for fruits and the growing realization by the farmers of the district that their lands are especially well adapted to fruit cultivation. Throughout the drumlin section, we find orchards on most of the southerly slopes because of the climatic advantages of such slopes, while the poor areas and unfavorable exposures are left for woodlands and pastures and are sufficiently extensive to supply the present demands. The sand-plain is still devoted to hay and garden crops

because they are still important, although less so than formerly. Thus, due to change in market demands, the region has gradually evolved from diversified farming practiced without regard to the best utilization of the land, to a system under which, insofar as possible, each type of land is devoted to the most profitable crop to which it is favorable.

BOOK REVIEWS

DEPARTMENT OF COMMERCE

Bureau of Foreign and Domestic Commerce

Industrial Structure of New England. By Charles E. Artman. Price, $1.30.

The important elements that form a background for New England's commercial and industrial development are its natural characteristics, including its location; its physical structure and climate; its native resources in soil, forests, minerals, and fisheries; and the number, types, and distribution of its population. These have determined the form and growth of its industry and the extent of its commerce. The topography and climate of the region have influenced the development of a rugged, enterprising, self-reliant population, and have given impetus to specific forms of industrial development.

Much space is given to a detailed presentation of the various manufacturing activities. An introductory section presents a general picture of the nature, importance, diversity, and trends in New England manufacturing as a whole, and its position in the industrial life of the Nation. Analysis is then made of each important line of manufacture.

Ocean Routes in United States Foreign Trade. By A. Lane Cricher. Trade Promotion Series No. 96. Price, 10 cents.

This is a survey of our ocean trade routes to and from foreign countries, and was accomplished after intensive research. It is illustrated throughout with maps and charts.

Inland-Waterway Freight Transportation Lines in the United States. By L. P. Nickell and W. S. Abernathy. Domestic Commerce Series No. 32. Price, 30 cents.

This is the first directory of its kind prepared by this Bureau; however, it is the plan to revise it from time to time as the need justifies. It comprehends all inland waterways in the United States, such as rivers, canals, bays, sounds, and lakes, exclusive of the Great Lakes. It includes a map of the Inland Waterways of the United States.

The Motorization of North Africa. By H. C. Schuette. Trade Information Bulletin No. 689. Price, 10 cents.

There are, naturally, many vital problems incident to the growth of the automotive market in North Africa, such as distribution systems, agencies, financing, and particularly servicing. These and many other questions, as well as pertinent basic economic data, are dealt with in this report, which will undoubtedly be of great interest and benefit to American exporters of automotive products.

The Coffee Industry in Brazil. By Walter Gay McCreery and Mary L. Bynum. Trade Promotion Series No. 92. Price, 20 cents.

An attempt has been made in this bulletin to present a description of the numerous phases of the Brazilian coffee industry; this description, while not unduly technical, is believed to be sufficiently detailed to be of value and interest to those who are engaged in the coffee business.

Markets for Fruit Juices and Fruit Sirups in Continental Europe. By John A. Embry. Trade Information Bulletin No. 683.

In order to find foreign markets for American fruit juices and fruit sirups, a survey was made of the production, use, and foreign trade in those products in European countries. Fruit juices and sirups are at present used to a rather small extent in the countries of Europe, but in most of them their use is increasing. There is a considerable production from domestic fruits, but taking Europe as a whole, there appears to be a possibility of developing a market for imported fruit juices and sirups.

Foreign Trade of the United States, in the Calendar Year 1929. By Grace A. Witherow. Trade Information Bulletin No. 684.

In the geographic distribution of foreign trade the value of exports to those continents taking chiefly finished manufactures showed the greatest increases, and for South America the gain was as high as 12 per cent. Exports to Europe and Asia were slightly less than in 1928 as a result of their smaller purchases of farm products. Imports from each continent increased in value as compared with 1928, the gains for South America, Europe, and Asia being particularly pronounced.

Finland: An Economic Review. By Alvin C. Eichholz and Herbert Rodeck. Trade Information Bulletin No. 681.

This study aims to review the basic economic conditions of Finland in such a way as to give a clear appreciation of the present status and the future possibilities, particularly in their bearing on international trade.

The Price of Silver. By Herbert M. Bratter. Trade Information Bulletin No. 682.

American Underwriting of Foreign Securities in 1929. Trade Information Bulletin No. 688.

German Chemical Developments in 1929. By William T. Daugherty. Trade Information Bulletin No. 690.

European Motion-Picture Industry in 1929. Trade Information Bulletin No. 694.

Airports in Latin America. By J. Warren Engle and Brower V. York. Trade Information Bulletin No. 696.

This bulletin is devoted to airports, landing fields, and weather conditions in Latin America.

The Market for Foodstuffs in Guatemala. By H. P. Macgowan. Trade Information Bulletin No. 678. Price, 5 cents.

Foodstuffs of various kinds to the value of about $4,000,000 are imported annually into Guatemala, and it is estimated that about 90 per cent of the total is supplied by the United States. Some of the principal imports are flour, rice, wheat, canned fruit and vegetables, crackers and biscuits, packing-house products, dairy products, and dried fruit. There is only a small market for some of these products, but the demand for others is increasing.

The Marketing of Nickel. By J. W. Furness. Trade Information Bulletin No. 685. Price, 10 cents.

Throughout the world the industrial nations have, during the past few years, required ever-increasing amounts of alloys. So rapid, indeed, has been the increase in demand as to presage the dawn of an alloy age.

The part played by nickel in this development is a most important one, in that nickel when alloyed with iron and carbon, as well as chromium, tungsten, vanadium, molybdenum, cobalt, etc., imports to the resultant product physical properties that cannot be duplicated in their entirety by the use of any other metal; various combinations of nickel and copper possess great resistance to corrosion and erosion, thus prolonging many-fold the usual life of the material.

At present the world's consumption of metallic nickel approximates 40,000 tons a year. The increase since 1923 (when consumption was about 31,000 short tons) shows what can be accomplished by intensive research work directed along the lines of collecting and disseminating information on the properties of metals, investigating the rational and economic scope of their industrial application, and searching for possible new uses. Not only has this policy, carried out by individual organizations, been remunerative to the industry as a whole, but it has brought about a better understanding of the many uses to which nickel may be applied.

Installment Selling of Automobiles in Oceania, Asia, and Africa. Trade Information Bulletin No. 686.

The value of United States automotive exports during 1929 to Oceania was $56,548,958, to Asia $61,897,739, and to Africa $30,562,115, a total of $149,008,812 and an increase of nearly 15 per cent over the total of $129,816,000 for 1928. In those continents the American vehicle predominates, accounting for nearly four-fifths of total registrations in both Oceania and Asia and approximately two-thirds in Africa.

Markets for Sawmill and Woodworking Machinery in South America. By Charles H. Ducoté. Trade Information Bulletin No. 687.

The countries of South America present widely varying markets for sawmill and woodworking machinery. Some factors, however, are common to all. Hand labor is generally rather cheap; sawmill and woodworking industries are characterized by many small units requiring comparatively simple machinery; and, wherever any important demand for machinery exists, considerable competition is encountered from European manufacturers.

Several South American countries are richly endowed with forests; but the timber is so inaccessible or so widely scattered in many cases that it cannot be exploited commercially except with great difficulty; and much lumber is imported. That condition restricts the market for high-grade sawmill machinery, and the smaller portable mills are fairly numerous. In Argentina there is an exceptional opportunity in connection with the quebracho industry, in which an attempt is being made to use scientific methods and modern machinery.

This bulletin describes in some detail the sawmill and woodworking industries of the various countries of South America, the type and origin of the machinery now in use, and gives suggestions as to the best methods to secure new business, with the purpose of giving the United States exporter a practical idea of the present situation.

Markets for Sawmill and Woodworking Machinery in Scandinavia and the Baltic States. By T. O. Klath. Trade Information Bulletin No. 691.

With the exception of Denmark, the Scandinavian countries and the Baltic States are characterized by extensive forest areas. These have given rise to sawmill and woodworking industries which in most of the countries are very important, if not the most important, activities. Hand labor is commonly used in the Baltic States, but in the other countries the sawmill and woodworking industries are rather highly developed and there is a correspondingly active market for high-grade sawmill and woodworking machinery.

While the market is highly competitive, it is believed that sales of American plywood machinery can be increased steadily, and that there is room for expansion in other lines. To assist in accomplishing such results, this bulletin describes the sawmill and woodworking activities in the various Scandinavian and Baltic countries, outlines the methods now being followed, shows the various types and origin of the machinery in use, and gives practical hints as to the best way to expand old and secure new business.

Salvador as a Market for Foodstuffs. By H. P. Macgowan. Trade Information Bulletin No. 692.

Salvador spends annually nearly $2,500,000 for imported foodstuffs, about 72 per cent of which is expended in the United States. Most of these food products are shipped from our Pacific coast ports, but the opening of rail communication with the Caribbean through the Guatemalan port

of Puerto Barrios is expected to alter the situation. American exporters who ship through Atlantic and Gulf ports now have a better opportunity to enter the Salvadorean market than at any time in the past. European shippers will also be able to take advantage of this shorter haul, however, and the indications are that competition will become keener than ever.

Flour, lard, hams, canned meats, canned fruits and vegetables, sardines, fresh and dried fruit, fresh and dried vegetables, crackers, canned milk, butter, and cheese are among the more important items shipped from the United States to Salvador.

Though economic conditions in Salvador are at present unsatisfactory as a result of the current weakness in the price of coffee, the commodity which accounts for over 90 per cent of the country's exports, this is a good time for firms contemplating future extension of distribution to Central America to survey the market, estimate the potential demand for their products, and arrange for sales representation.

Fruit Markets in Eastern Asia. A joint investigation by the United States Department of Commerce and the University of California.

While the investigation confirms what we already know in regard to the situation, it is of value because of the thorough method by which it was carried out and should help to definitely settle many questions that have been raised in regard to the possibilities of a wider market in the Orient.

The conclusions indicate clearly the limits of the present market; they also point out that further expansion is largely dependent on the development of greater purchasing power and higher standards of living for the masses of the Orient. Many believe that this will come slowly and that it promises a potential market some time in the future. If this is true, it justifies careful planning and study of the food habits in the Far East and careful watching on the part of exporters for changes in standards of living, changes in food habits, and the development of greater purchasing power.

Railways of South America, Part III: Chile. By W. Rodney Long. Trade Promotion Series No. 93. Price, $1.30.

This monograph presents detailed information with respect to all the railways of Chile, covering such phases as the development, mileage, operating officials, methods of purchase, finances, traffic statistics, characteristics of right of way, number of employees, motive power, rolling stock, repair shops, and equipment, as well as an analysis of the railway supply market.

The report was prepared by W. Rodney Long, of the Transportation Division of the Bureau of Foreign and Domestic Commerce, through the coöperation of various locomotive and car building companies, manufacturers of railway equipment, exporters of crossties, and other interested companies, with the Transportation Division, the Machinery Division, the Iron and Steel Division, and the Electrical Division of the Bureau.

This is the fifth of a series of reports on railways in Latin American countries. Preceding numbers, all issued in the Trade Promotion Series, are as follows:

No. 5 Railways of Central America and West Indies.
No. 16 Railways in Mexico.
No. 32 Railways of South America: Part I, Argentina.
No. 39 Railways of South America: Part II, Bolivia, Colombia, Ecuador, Guianas, Paraguay, Peru, Uruguay, Venezuela.

The sixth and last volume in this series, covering Brazil, will appear in the near future.

Chain-Store Developments in Great Britain. By Ralph S. Charles. Trade Information Bulletin No. 697.

International Trade in Mica. By Joseph Ulmer. Trade Promotion Series No. 95. Price, 15 cents.

National Retail Credit Survey, Part I. Domestic Commerce Series No. 33. Price, 10 cents.

Preparing Shipments to Canada, Documentation and Customs Entry. Trade Promotion Series No. 91. Price, 10 cents.

Employment for Americans in Latin America. Fifth Edition.

Discussion of the limited opportunities for employment of Americans in Latin American countries.

Index to Commerce Reports, Nos. 1–13, Volume I, Thirty-third Year, January–March, 1930. Single copies, 5 cents; annual subscription, 20 cents.

This index is issued quarterly and lists all material published in Commerce Reports by subject, country, and author.

U. S. COAST AND GEODETIC SURVEY

Hydrography. Slope Corrections for Echo Soundings. By A. L. Shalowitz. Special Publication No. 165. Price, 10 cents.

Description of method used in taking depth soundings for ocean surveys.

Seismology. Progress of Seismological Investigations in United States, July 1, 1927, to January 1, 1930. By N. H. Heck. Special Publication No. 167. Price, 5 cents.

This report on earthquakes was made to the section of seismology of the International Geodetic and Geophysical Union of the International Research Council.

BUREAU OF THE CENSUS

Manufactures. Census of Manufactures, 1927. Summary by Industry Groups and by Industries. Price, 10 cents.

HELEN M. STRONG.

Pack, Charles Lathrop, and Gill, Tom. *Forests and Mankind.* x and 248 pp.; bibliography. Macmillan Company, New York, 1929.

During the last twenty years the notion of forestry had acquired a great popular appeal. A persistent and skillfully directed program of public education, carried on through the press, through civic organizations, and by other means, has gained for forestry a widespread interest and a considerable degree of popular approval. Despite this, by a surprisingly large number of laymen, including some ardent conservationists, the scope and aim of forestry is misunderstood. Many confuse forestry with forest conservation, others with artificial reforestation.

Forests and Mankind is a story of forestry, its objectives and practice, written in the interest of furthering popular belief in forestry and an understanding of its problems and aims. It acquaints the layman, who may be an advocate of forestry on the ground of conservation, with the fact that it is concerned with the use, as well as the saving, of the forest; with harvesting trees as well as planting them; that forestry is the business of producing crops of forest products, just as agriculture involves the production of crops of other sorts.

The authors begin with a short discussion of the physiology of the tree, from which they proceed to a consideration of the relationships of and within communities of trees, giving some notion of forest ecology. The geographic distribution of forests and forest types of former ages, the dynamism of forest communities, and their environmental modification during countless ages, leads to the consideration of present forest distribution, particularly in the United States.

The remainder of the book is concerned with forestry, its definition, its application in the United States, and its many ramifications. A chapter describes the system of National Forests, others describe the various products of the forest, and one touches the relation of forests to wild life.

The problems of fire protection, insect control and eradication, and waste in utilization are given merited attention. Forestry in its relation to agriculture and its application in farm economy and the future of industrial forestry are treated at some length. The authors conclude with a statement of the inevitable need for forestry, and a plea for its hasty inception, in order to avoid national forest bankruptcy. The book is nontechnical, interestingly written, and excellently illustrated.

CARLETON P. BARNES.

Yoder, F. R. *Introduction to Agricultural Economics.* xix and 472 pp. Thomas Y. Crowell Co., New York, 1929.

For the specific purpose that the author intended it—*i.e.*, to serve as "an introduction to the subject for beginning students" and to lay down the elementary principles of economics, the *Introduction to Agricultural Economics* seems, on the whole, a well-planned and well-executed piece of work. To eliminate debatable and borderline elements is a highly commendable practice for an introductory exposition of the subject. His differentiation between agricultural economics and farm managements tends to further clarify the purpose and scope of the respective subjects. He writes that "Farm management is concerned with the principles governing the successful and profitable operation of the farm from the point of view of the individual owner or operator. Agricultural economics is concerned with the economic principles underlying agriculture as an industry."

After the introductory chapter dealing with a history of American agriculture and agricultural economics, which constitutes an adequate orientation for the immature student, the author endeavors to depict the present rural situation as soon as the subject has been defined, the field delineated, and certain basic conceptions postulated.

A discussion of the constituent elements of the field follow in logical sequence: Land as a Factor in Agricultural Production, Land Income and Land Value, Land Tenure and Land Policies, Social Capital, Credit, Insurance, Loans, Farm Management, Marketing, Foreign Markets, The Tariff, Taxation, and Farmer Movements.

The treatment of the subject throughout most of the chapters is elementary, but necessarily so in view of the student's usual previous preparation. The chronological method of approach employed in certain chapters is interesting and effective. Portions of the chapters on Price Economy, Land Income and Land Values, Foreign Markets and Farm Taxes should prove stimulating to the neophyte. The inclusion of information relative to the recent formation of additional credit institutions serving the farmer is timely and suggestive.

Certain chapters dealing with the elimination of the middleman, government price fixing of agricultural products, and the effectiveness or ineffectiveness of the tariff might well be read by the farming population as a whole. To strike out blindly against all middlemen and to denounce by the use of blanket statements all of their activities is to display an ignorance of elementary economics and a decided lack of judgment. There are certain functions undertaken by the middleman that can be performed most economically by him and the author recognizes the services rendered by the great coöperative associations like the California Fruit Growers' Exchange, which sells through the wholesaler and retailer to the consuming public.

In a distinctly lucid and simple way, the matter of Price Fixing is presented. A number of agricultural writers, inspired more by the ethics of the situation than by the economics of it, would have the government allow the farmer a certain profit above production costs; and thus would have the government on this basis make up deficits that might occur.

But how are production costs, the basic figures needed for the calculations and subsequent reimbursements, to be arrived at? The determination of these figures would be a simple matter if all farmers expended the same amount of time, labor, and capital, per unit of goods produced. But the latter situation is not the true state of affairs. An extremely variable factor, the human one, must be recognized. From current farm management surveys, the writer observes that the costs of producing wheat by farmers in different sections of the country range from 75 cents to four dollars per bushel; that of producing cotton ranges from ten cents to fifty cents per pound. The efficiency and ability of farm management varies with individuals; the cost of labor, land, rent, and interest rates vary with the locality, hence the difficulty of computing such a complex and variable figure. He also notes that "if the higher costs were taken, then price guarantees would encourage the inefficient farmer to continue production, acreage would be increased among the better farmers and the price would be further depressed."

A salient feature of this book is the clean-cut distinction drawn between effective and non-effective tariffs from the standpoint of farmers and other groups.

The normal consequences of the general enlightenment of the farmer and layman on the matter of the tariff would be far reaching in their significance. These results, no doubt, would include new political alignments and an increased pressure on Congress; they might even embody such visionary benefits as adequate constructive legislation and an improved economic status.

N. C. BURHANS.

Büsgen, M., and Münch, E. *The Structure and Life of Forest Trees.* Third, Revised and Enlarged Edition. xi and 414 pp.; index; illustrations. John Wiley and Sons, New York, 1929.

The translation of this excellent text in tree anatomy and physiology provides a comprehensive reference work that has not been adequately supplied by any work in English. The subject has, of course, received treatment in the literature of silviculture, wood technology, and plant physiology, but such treatment has ordinarily been supplementary or adjunctive to the main theme. Here, however, we have an entire volume devoted expressly to the study of the life processes and morphology of forest trees.

While not primarily ecological, the work deals extensively with the effect of environmental influences on the form and functional activities of the tree.

Dr. Münch, who has revised and edited Büsgen's original text, has devoted a chapter to the formation of "morphological local races," resulting from environmental influence. His statements regarding the inheritance of crookedness of bole suggest a belief in the hereditary transmission of acquired characteristics. His contention regarding the effect of heavy snow on crown form may seem valid on the basis of examples drawn from European forests, but there are North American trees (Bristlecone fir) that seem to refute it.

Dr. Münch advances a theory of the circulation of sap somewhat different than that generally held by plant physiologists.

The illustrations add immeasurably to the usefulness of the work. Both well-chosen photographs and unusually fine pen-and-ink drawings serve to enhance its value as a text. The chapter on "The Form of the Tree" has particularly noteworthy illustrations from the authors' experience and the exemplification of nearly every principle are pleasing features.

The specific examples, although drawn largely from European experience, are such that application can be readily made to North American genera. There is indicated an acquaintance with North American forest flora.

CARLETON P. BARNES.

Davis, Joseph Stancliffe. *The Farm Export Debenture Plan.* Miscellaneous Publication No. 5 of the Food Research Institute, Stanford University, California, October 12, 1929. x and 265 pages.

When Thomas Malthus formulated his dismal concept of population, it was predicated upon the ultimate pressure of population on the food supply. Today, in the United States, we are confronted by the means of subsistence pressing upon population, and the Congress is called upon to struggle with a surplus of food. The producer of this surplus asks for legislative aid in restoring and maintaining his purchasing power on a parity with that of producers in other fields. Since foodstuffs constitute by all odds the major product of agriculture and animal husbandry, food problems are thus in considerable part agricultural problems. The American farmer then is seeking to improve his own position by insuring the disposal of the entire crop at a figure commensurate with its cost of production.

The persistence of unsatisfactory conditions among farmers since the War has given rise to a number of plans for "farm relief." Chief among these legislative aids to the farmer has been the Export Debenture plan which came prominently to public attention in the spring of 1929. "Although not a part of the Agricultural Marketing Act of June 14, 1929, the debenture plan may be expected to reappear, in one form or another, until it is either adopted or finally rejected."

Under these conditions an analysis of the proposal is of more than academic interest.

In this publication of the Food Institute the author has produced a thoroughly readable study that is "not merely an exposition and analysis of the export debenture plan, but as well comprehends an interpretation of the agricultural situation, some appraisal of the grounds for farm relief of various sorts, and a consideration of many arguments that apply to the several types of proposals." Although this plan is commonly regarded as applicable to any farm product and manufactures thereof, of which we do or may produce an export surplus, the author has dealt mainly with wheat.

"The export debenture plan is avowedly a price-elevation scheme, since practical difficulties seem to preclude the possibility of curtailing production. It seeks to raise farm prices of agricultural products of which the United States produces export surpluses, and to raise domestic prices above export prices of these products." As in the case of the McNary-Haugen plan with its equalization fee, it is predicated upon the low purchasing power of farm products as the major cause of agricultural difficulties. While prices of farm products and prices in general have been higher than before the War, the advance has been much less in farm prices than in prices of goods and services that farmers must buy. It is assumed that the United States is definitely committed to a protective tariff policy; this plan "seeks to make the tariff effective" on these farm products, at least in part, by establishing domestic farm prices on a higher level than would otherwise be the case. It is implied that the prices of other farm products would rise also, thus increasing the farmer's income. It is then the farmer who is to be aided, not agriculture.

The writer feels that as a measure for surplus-control the export debenture plan has its serious shortcomings, due in large part to the inelasticity of the plan for controlling surpluses of varying amounts. In practice, he feels that it would fail to yield the promised advantages. Like the equalization fee, this plan seeks to effect a redistribution of national income in favor of the farmer, although it does not, in his opinion, partake of the nature of a subsidy to the farmer. This issuing of debentures to export merchants and their redemption in payment of import duties is preferable to a cash subsidy on legal, administrative, and psychological grounds.

In the succeeding chapters the author goes into some detail to present the case for the export debenture plan, its sources of support, the prospective cost and permanence of the plan, the probable effect its adoption would have on farm prices and on the acreage of certain crops, and the experiences of other countries with a somewhat comparable scheme, respectively. There is throughout the very evident desire on the part of the writer to do justice to all phases of the problem. It is, as he says, an ingenious and exceedingly plausible plan for farm relief. Its similarity to the protective tariff in particular he seeks to establish is not at all what proponents of the debenture plan assert. In this instance he points out that a protective tariff has been regarded as a means of fostering undeveloped industries or of maintaining those which are unable to supply the domestic market in the face of foreign competition; whereas the debenture plan is addressed to well-developed agricultural export industries only. That, however, is not to be construed as a defense of the tariff.

"The major test of the operation of the scheme would come after the first year of its operation, when the adoption of the price raising plan would have time to exert influence on acreage, production, and exports of the debenturable products. There is every reason to expect fairly prompt, definite, and substantial increases under the natural stimulus afforded by the measure, except in those cases where none of the product enters into export trade. The result of increased output and exports would be to cause recessions in prices abroad and export prices here, so that, even though domestic prices were kept above normal export parity, the net increase in prices would be greatly reduced if not eliminated." So far as farmers are concerned, the benefits in a few years would have vanished, in large part or entirely, and with them the burdens upon the consuming public. On the other hand the Treasury burden would be materially larger, in consequence of the enlarged exports, and the justification for this burden, in genuine benefits to farmers, would have largely disappeared. Upon the debenturability of the product would depend the rate at which this would take place. "As it now stands, the consideration of this debenture plan must be taken in the light of the present Federal Farm Board, to which it is less a supplement than it is a contrasting alternative." It is possible that this plan or some modification of it may in time have genuine merit, but just now it is the opinion of the author that to pursue farm relief up this path would be to court disaster.

ALFRED J. WRIGHT.

Rumma, J., Grano, J. G., and Veski, J. V., editors. *Eesti. Kodu-uurimise töö.* (Estonia. A study of home.)

I. Tartumaa. 1925: 140 pp., 20 maps.—The work is a cyclopedical study of the geography, economics, and history of the Province of Tartu, Estonia, based upon archaeological findings, documents in archives, published sources, and original investigations. The material is divided into two main sections: general and special. The general section dealing with the Province as a whole is subdivided under the following four headings: location, statistics, nature, and man. The subsection on nature consists of the following chapters: geological formations, surface forms, their development, climate, waters, flora, fauna, and

landscapes; and the subsection on man: habitations, inhabited places, ways of communication, economic conditions, intellectual and spiritual life, hygienic conditions, history, education, language, and ancient history. In the special section, for the units of study, parishes, towns, and cities are taken. The material in each chapter is classified under the same headings as in the general section. The work gives a comprehensive picture of the past and present of the Province, with emphasis on the city of Tartu as the Provincial seat and the center of higher learning in Estonia. In the chapters on parishes, of special interest are the histories of the large landed estates (feudal latifundias) formed centuries ago and having lasted up to the independence of Estonia. The geological descriptions appear to be done with much detail and with painstaking care. Scientific methods are applied. The historical events are described and analyzed from a strictly objective point of view. The editors and contributors are largely faculty members of the Estonian University at Tartu.

II. Võrumaa. (Province of Võru.) 1926: 497 pp., 10 maps.—The same arrangement of material and the same methods are used as in Part I. In this volume the chapter on provincial history commands closer attention. The Province of Võru was the southeastern corner of Estonia up to 1920. As a boundary province it was the scene of constant three-cornered conflicts and wars. The native Estonians fought both invaders, Germans and Russians; Germans fought Estonians and Russians; and the Russians, in their turn, fought Estonians and Germans up to the last war in 1919, which was again a three-cornered struggle between the same opponents.

III. Setumaa. (Province of Setu.) 1928: 381 pp., 5 maps.—The material is presented in the same manner as in Parts I and II, except that instead of being divided into parishes as units of study, the Province is divided into four areas on the basis of common geographical features. The description of a considerable group of people inhabiting the Province, called Setu, and numbering over 15,000, is of special interest. These Setu are ancient Estonians. They were incorporated into the Russian Province, Pskov, and were part of it for over seven centuries. The attempts to Russianize them failed. They were christianized into the Greek Orthodox faith; but, as the Russian priests did not speak Estonian and the Setu could not understand Russian, the influence of Christianity upon the Setu was so superficial that they continued to worship their pagan idol, Peku, in their homes practically up to our day. Although the Setu took over from the Russian a number of words and changed certain vowels, yet they have preserved the forms and pronunciation of the ancient Estonian language to a much larger extent than the modern Estonians themselves.

PETER A. SPEEK.

Loomis Havemeyer. *Ethnography.* iv and 522 pages, 225 illustrations, 3 maps, bibliography and index. Ginn and Company, Boston, Mass., 1929.

G. Elliot Smith. *Human History.* xi and 472 pages, 67 illustrations, bibliography and index. W. W. Norton and Company, New York, N. Y., 1930.

The human geographer will welcome these volumes as source material for the study of man. Although neither is written from a geographical standpoint, much of the material deals with environmental influences. This is particularly the case with Dr. Havemeyer's book on primitive man. *Ethnography* is not a systematic treatise, but rather a collection of quotations skillfully woven together and designed to serve as supplementary reading in a college course. The book deals with a few tribes in each of the main races and in each case discusses the conditions of environment, racial characteristics, self maintenance, perpetuation and gratification, religion, and regulative organization. The major emphasis is on the social life of the people. Twenty tribes or peoples are described in all, of whom eleven belong to the black race, two to the brown race, four to the red race, two to the yellow race, and one to the white race.

Human History also deals with primitive society but treats it from the developmental standpoint. This book is an account of man's history from earliest prehistoric times to "the glory that was Greece." Opening chapters deal with the wanderings and industries of our early ancestors and are followed by a consideration of the races of mankind, and of the characteristics of primitive man, which the author holds to be gentle and quite un-"savage." The beginnings and rise of civilization occupy about half of the book, with material on Egypt, Crete, Greece, and other countries. Dr. Smith has attempted to cover both the natural history and the social activities of man. Such an attempt to bridge the unfortunate gap between science and the humanities is commendable, and anthropologists will doubtless agree that Dr. Smith has made a real contribution toward this end.

GEORGE B. CRESSEY.

Alcaraz, Eurique. *Climatologia Agricola.* Two volumes. Volume I, 217 pages, 26 diagrams and tables, 22 maps, index. Volume II, 374 pages, 13 diagrams, 90 tables, 14 maps, appendix, and index. Madrid, 1925.

Mr. Alcaraz, professor in the Special School of Agricultural Engineering at Madrid, has presented in the *Climatologia Agricola* a good summary of weather and climate and has emphasized the biological life in Spain in relation to climate.

The general plan of the work consists of three parts. The first division, Volume I, includes a geographical résumé of the distribution of the land and the seas of the earth and continental

relief. It also contains a discussion of the general geographical distribution of insolation, temperature, pressure, winds, ocean currents, humidity, cloudiness, precipitation, soils, biological forms, and human activities and their relations. The first nine chapters are devoted to general laws of meteorology and climatology, and the division of the earth into climatic zones thus preparing the reader for the agricultural and natural life discussions which follow.

Chapter X is devoted to the formation and the distribution of soils in relation to climate. He divides the soils into the following formations: laterites, desert, sub-desert, vegetal (black earth and loess), humic (acid soils and podsol), tundra, and turbosa. General characteristics and the distribution of each are briefly discussed.

In Chapter XI, the relation of exterior conditions especially upon animal and plant life is treated as biogeography. He groups the plants into tree, liana, herb, and epiphytic divisions and classifies the animals according to those which live in and on the earth, in the air and in water. A summary of the classifications by eminent biologists is included.

Chapter XII is a general summary of the relation of animals and plants to climate and soils. Volume I includes 22 maps, six of which represent rather inaccurately the relief of the continents; the others show the distribution of isotherms, isobars, winds, ocean currents, paths of cyclones, and anticyclones.

Volume II contains the second and third parts of this work. The second part, "Climatologia Descriptiva," gives the general classification of climates, physical characteristics, biologically and agriculturally. The author briefly describes and classifies the climate as follows:

With wet periods	Hot without dry periods—equatorial
	Hot with dry periods—tropical
	Temperate without cold periods—subtropical
	Temperate with cold periods—temperate
	Cold with periods of moderate warmth—frigid
Without wet periods	Hot without cold periods—deserts
	Temperate with cold periods—fell type
	Cold without temperate periods—tundra or arctic

The world vegetation is divided into zones and geographical regions are given for each. The zones are as follows: Arctic, northern forests, northern steppes, Mediterranean, Chinese-Japanese, Sahara, tropical, southern steppes, southern El Cabo and Chile, southern forests, Australia, Madagascar, and Oceania.

The zoological regions are as follows: Palearctic, including the frigid and temperate zones of the old continents; Nearctic, comprises the frigid and temperate zones of the new continents; Oriental, comprises the hot zones which are affected by the monsoons; Etiopica, extends through all of equatorial Africa and tropics influenced by warm, humid climates; Neotropical, extends from Central America and south where the climates are hot with humid periods; Australian, includes nearly all of Oceania influenced by hot, temperate and dry climates.

Chapters II to V contain descriptions of the flora and fauna as classified and include the principal families and genera. The discussions dealing with climate contain many tables showing temperature and precipitation at various stations in each region. A brief summary of agricultural conditions is included with each climatic region.

Part three, "Climatologia Iberica," nine chapters, contains a good description of the climate of the Iberican peninsula. The writer divides the country into physiographic and climatic divisions and discusses the meteorological influences affecting the climate. The two climatic groups are given as (1) those influenced by the Atlantic: maritime, transition, and continental; (2) those influenced by the Mediterranean: maritime and continental. Tables showing the precipitation, humidity, and temperature are given for each region. The relation of climate to plants, agriculture, and animals are discussed in each region. This part of the work is most complete and makes a good reference on Spain.

Thirteen colored maps show the climatic regions of the continents and countries discussed in the text. However, the keys to the colors of the maps are on separate pages and hence are not as usable as they should be. The author seems to make no reference to the maps in his textual material and hence they do not appear very valuable. Some of his diagrams are so small that the print cannot be read with ease. Although the title of the book is "Climatologia Agricola," the author gives very little emphasis to agriculture. The work, however, contains much valuable data and is a good reference written in Spanish. It is particularly valuable for the material on the Spanish peninsula.

ESTHER S. ANDERSON.

Agar, Flint, and Longwell. *Geology from Original Sources.* xxi and 527 pp., 70 plates, and 16 text figures. Henry Holt and Company, New York, 1929.

The authors at the outset state clearly that this volume is not a textbook in geology; that its mission is to furnish such supplementary material that the young student will come to realize early the significance of the subject as something of human development. Their purpose in this respect appears highly commendable. Human Geography has intrenched itself as a popular and worthwhile subject. Why should not geology likewise present its human aspects?

The book is an orderly compilation of authentic, interesting articles arranged so as to bear specifically upon the phases usually treated under Physical Geology. Their arrangement is

not that of any rigid sequence; readings can be selected to fit the scheme of instruction which may be based on any of the standard texts. The lack of rigid sequence adds to the elasticity of the work as a reference book and thereby widens its potential usefulness. Fourteen groups of readings are listed as chapters, beginning with "Minerals and Rocks"; "Climate, Weathering and Soils"; and continuing with "Streams and Valleys"; "Glaciers and Glaciation"; "Ground Water"; "Lakes and Swamps"; "Shorelines"; "Sediments and Sedimentary Rocks"; "Volcanoes and Volcanism"; "Movements of the Earth's Crust"; "Metamorphism"; "Land Forms"; "Geology in Modern Life"; and "The Scope and Method of Geology."

The titles of the chapters suggest the diversity of readings presented but they do not give much indication of the richness of the contents. All agree that wide reading in connection with college studies is essential to true understanding and to the development of culture, but in most cases beginning classes are too large and library facilities are too meager to make this procedure feasible. Here, however, the works of the masters of the science are presented, selections from some of the notable pioneers in the field are placed within reach side by side with those of modern scholars. Readings from Dana, Huxley, Lyell, Geikie, I. C. Russell, Gilbert, and Powell are presented as classics, as are also some of the best-known writings of later workers ranging from W. M. Davis, Chamberlin, Penck, to those of Huntington, Bowman, and Johnson. Therein is the real contribution; the student is led early into some acquaintance with the original works in the field of geology, a goal worthy of unstinted commendation.

NELS A. BENGTSON.

Jones, Clarence F. *South America.* x and 798 pp.; maps, charts, tables, and pictures. Henry Holt and Company, New York, 1930. 9½ x 5½ inches. Illustrated, $6.00. Students' Edition, $4.75.

This volume represents a detailed and practical treatment of the geography of South America. It is a notable contribution to the geography of South America and fulfills a marked need in the teaching profession. No textbook, in the field of geography, that has come from the press during the past decade has been more desirable than this volume, especially to colleges and universities that offer courses on the geography of South America.

The author's many months of travel in South America and his years of research have made him one of the leading authorities on the geography of that great continent. He has written a thorough-going and scholarly textbook, based upon accurate first-hand information. The book should be very attractive to the students of geography and also to capitalists and commercial men, as the discussion embraces the major topics that might be of interest to the American business man.

South America is organized primarily on a regional basis. The first chapter presents a brief picture of South America through the centuries from the time of Pizarro through years of its development up to the present economic penetration of foreign capital and men.

Chapters II to VI inclusive treat in some detail the general aspects of physiography, climate, natural vegetation, transportation, and the people and their major problems.

In the regional chapters the author begins with a treatment of the Falkland Islands. Though less significant and less South American than most any other portion of the continent, these islands provide a unique and logical way of opening the discussion because of their geographic and economic simplicity. Throughout the regional chapters emphasis is placed upon physical factors and the economic adjustments to these factors. Though the volume is largely a regional geography, the identity of the several republics has been maintained. For each of the large republics a chapter introduces the country and gives in some detail the historical background so important in all South American countries.

The book is illustrated with 334 pictures and maps. Sixty per cent of the pictures are from the author's own camera. The black and white distribution maps and the regional map in the back of the book are distinct contributions to the literature of the continent.

From the teaching standpoint the book is excellently put together. It consists of 50 well-organized chapters, with an average length of pages. The style is free and lively, but not overdone. There is a splendid well-selected bibliography of more than 40 pages. The index is an unusually valuable one for the teacher because of the organization and details of it. In addition, the print is of good size. This book should be, for a long time, the standard textbook on the geography of South America.

The book is a handsome well-bound volume. The publishers are to be congratulated upon the appearance and general make-up of the book.

HARLEY P. MILSTEAD.

Editorial Staff of the Committee on the Study of the City. *Tartu.* 728 pp., 1927.

An Estonian cyclopedical study of the history, geography, and economic and social conditions of the city of Tartu in Estonia, by a staff of editors and collaborators invited and appointed by the city government, principally from the faculty members of the Estonian University of Tartu, and published by the city government. To the volume are added 17 separate maps, plans, and statistical tables. There are also numerous photographic illustrations and charts in the text. To the titles, subtitles, and terms used in the text are added French translations, and to the en-

tire work is added a summary of 78 pages in French.

The work contains informative data, with interpretation, in regard to the city of Tartu as a whole. It is divided into three main parts:

A. History—6 chapters by 3 authors. This gives for the first time a systematic historical review of the city from the time of its founding up to the present time, including its topographic history. The data are based upon published documents and non-published materials contained in various archives.

B. Geography—by Mag. Edg. Kant, with an introduction by A. Mieler on the geomorphology and hydrology of the location of the city. This geographic part of the work is done with such scientific thoroughness that it commands the close attention of students of geography, especially the geography of cities.

The visualization of the comparative growth of the population of the city through tonograms and the charting of the comparative time-length and the degree of intensity of sunshine and sunlight and the fluctuations of the temperature together with atmospheric pressure through a series of arithmograms are noteworthy.

For the above geographic part, its author, Mag. Edg. Kant, was awarded the Eduard Gaudy Medal by the Société de Geographie Commerciale de Paris in 1927.

C. General Part—24 chapters by 22 authors. This section gives a general picture of the present condition of the city as to population, architecture, industry, finance, education, and welfare work.

On the whole the work is a well-planned and well-executed study of the past and present of a city by modern scientific methods. It has attracted attention in a number of West-European countries. For instance, in Sweden it was made the subject of a study by the geography seminar in the University of Stockholm.

No such remarkable work was undertaken or attempted, or even conceived, in Estonia under the German or Russian régimes. Therefore, this work should also be considered as the demonstration of the intense ambition of the younger generation of scientific students in a state newly formed since the World War to gain notice and appreciation outside of their own hitherto obscure group.

PETER A. SPEEK.

Verrill, A. Hyatt. *Old Civilizations of the New World.* v and 393 pp.; illustrations, bibliography, index. The Bobbs-Merrill Company, Indianapolis, 1929.

Old Civilizations of the New World by the very versatile A. Hyatt Verrill is a discussion of the more popular phases of the archeology and ethnology of the new world. The book is written with the aim of making a general summary of the highlights of the great civilizations and cultures of America, some of which are even older than those of Egypt. *Old Civilizations of the New World* is written in a fascinating style with scientific skill and accuracy and yet the personal element is largely lacking. One can hardly believe that the author has travelled over sixty-six thousand miles in the collection of materials for his book. The book is intended for an introduction to the subject written primarily for the general public.

The book is about 400 pages in length; it has 56 illustrations and many sketches. As a special feature the book contains some of the best known and most popular Incan music, which has been rearranged for conventional instruments and has been previously published in Peru.

The first five chapters summarize the prevailing theories of the origin of life in America, the early cultural developments and their influences on man, and the mysterious problems of early civilizations. The conflicting theories of the origin of man in America are ably summarized with attempts to analyze and to correlate them. One theory maintains that ancestors of Indians reached America by way of Greenland. Another theory quite commonly accepted deals with the passage of Asiatics to America by way of Bering Strait. Other theories have tried to prove the descent of the Indian from the Norse Vikings, the lost tribes of Israel, or the inhabitants of a "lost" mid-Pacific continent. The author suggests that the ancestors of the Indians may be from more than one source. Thus, the Pacific coast tribes may have originated in the mid-Pacific islands or Oceania. Other peoples may have come across Bering Strait. Others by way of Greenland, and still others by way of southern Europe. These migrants may have found man in America and the resulting intermingling may have produced the wide diversity of types and tribes of America. In the remaining nine chapters the author gives a detailed discussion of the most important early civilizations giving a picture of these peoples as they really lived as gleaned from all possible existing records. Some of the people described are the Aztecs, the Toltecs, the Mayas, the Incans, and the Pre-Incans. The chapter on Coclé culture is based upon the author's discoveries in Panama in 1924 and is, of course, the most original and most thorough part of the work. Coclé culture is believed by the author to be the oldest of known advanced cultures in Central or South America.

The scope of the book is very broad. Volumes have been written upon the subject matter here outlined in a single chapter. Many books have been written on the Mayas alone while the discussion here is condensed into 60 pages. The same is true in the case of the Incans. The author has attempted, however, to give the broad general picture with greatest emphasis on the sections with which he is the most familiar. This is certainly justifiable in the case of an introductory book.

The book is of interest to the general public,

and to the historian and the geographer. To the historian it will give a general background of the early civilizations of America without the technical language which hampers those not familiar with archeology and ethnology. To the geographer it suggests manifold and varied problems in the influence of environment upon early mankind. The author shows that climatic, meteorological, and geographical factors exert a tremendous influence upon cultural development controlling the type of utensils, implements, and weapons necessary for successful existence and the gradual development of culture. Tribal cultures vary greatly from forest environment to open plain environment. The author forcibly suggests a physiographic or perhaps a climatic change which has altered once prosperous civilizations to dreary wastes. An example of this is found in the case of Tiahuánaco or dead city which is located far up in the heights of the Andes a few miles from the shores of Lake Titicaca which is believed to have receded and caused the desertion of the city.

ELIZABETH GREGORY.

Miller, W. J. *Introduction to Historical Geology.* xvii and 438 pages; maps, drawings, illustrations. Third edition. D. Van Nostrand Company, 8 Warren Street, New York City.

The author, in his earlier editions, set himself to the task of presenting a résumé of geological history in such manner as to hold the interest of young college students or other intelligent readers. That he was successful was evidenced by the continued favor in which they were received during the past fifteen years. The changes necessitated by further researches and new discoveries have been important, yet in most respects they have not been revolutionary. This new edition, therefore, although completely rewritten, represents rather a refinement than a revision of the earlier works. The same systematic outline for each of the eras and periods has been followed, and students will have little difficulty in tracing the important evolutions of land forms and life forms because of the simple language and the systematic sequence in which they have been stated.

Recent discoveries bearing upon the age of the earth and the duration of each of the geological periods are given in relatively ample detail, necessarily brief, however, because of the space limitations placed upon the size of the book. The principal hypotheses of the origin of the earth are summarized with the chief points in favor of each as well as the objections stated clearly, and without adding any confusing notes the student is led deftly to realize at the outset that this problem is too great for hasty solution.

The clarity with which the evolution of life through the ages is presented is the strongest feature of the book; this should be expected perhaps. The paleogeography is subordinated as is also the economic aspects of the beds of the various geological ages. In a brief treatment some phases only can be emphasized and Professor Miller has chosen to emphasize the geological story of organic evolution. But since in his discussion of North America he relates many events and forms to definite localities, particularly in the United States, and refers to them by physiographic regions, one wonders why he persists in using the same generalized and unsystematic physiographic map that he presented years ago. The physiographic subdivisions outlined by Fenneman's committee and published by the Association of American Geographers is surely much better!

NELS A. BENGTSON.

Torgasheff, Boris P. *The Mineral Industry of the Far East.* 512 pp., 322 tables, 14 maps, bibliography. The Chali Company, Shanghai, China (6 Kiukiang Road). 1930.

In these days of international trade, it is not enough to study the resources of one country alone, for the utilization of any particular mineral deposit may be affected by the needs and production of neighboring areas. A favorable location or the presence of a dense population may lead to the development of deposits which under other circumstances might be worthless. This book is thus particularly valuable as a comparative study of the resources, production, and requirements of the countries of eastern Asia. The areas considered include China and Manchuria, Japan with Korea and Formosa, the Russian Far East, the Philippines, and Indo-China. There is also a survey of the world's mineral market.

Detailed information on the mineral industry of the Far East has been difficult to secure, and Mr. Torgasheff has presented a thorough and reliable study. The major emphasis of the book is economic. There are over 300 tables dealing with production, trade, and reserves compiled from hitherto scattered or unavailable sources and in most cases brought up to 1927. The information has been gathered directly from government agencies and private operators and has been carefully checked. The book forms an indispensable reference volume for students of the Far East and for all workers in economic geography.

The book is divided into five parts. The first deals with the eight countries or regions under consideration. For each area there are detailed tables of mineral production and an analysis of the reserves. Although Japan is probably the poorest of the countries in respect to her mineral wealth, she nevertheless leads the Far East in the value of mineral production per square mile, with an annual average of over $2,000. This may be compared with $1,660 for the United States and $200 for China. If, however, the production of mineral wealth be considered on a per capita basis, the Russian Far East is first

with $16 per year, while Japan has $4 and China but 85¢ per person, in comparison with $50 for the United States. Torgasheff considers that the Russian Far East, North Manchuria, Korea, and Indo-China are the most highly mineralized areas and that with suitable political conditions mining should develop rapidly. China proper has a considerable variety of metals, but aside from coal, the country appears to be entirely without large reserves.

The metals, non-metals, and fuels make up the next three sections. The occurrence and production of some sixty minerals are discussed in detail, with references to the companies, statistics of output, and the situation in world trade. The Far East is already an important source of minerals, producing 87 per cent of the world's antimony, 62 per cent of the tungsten, 30 per cent of the talc, 30 per cent of the kaolin, 24 per cent of the abrasives, 16 per cent of the arsenic, 16 per cent of the graphite, 14 per cent of the salt, 13 per cent of the magnesite, and 11 per cent of the pyrite. Other items of world importance are mercury, gold, feldspar, molybdenum, cement, bismuth, and tin. Coal is the most valuable product and the output is adequate for the present needs, with very large reserves in sight. In the case of iron and steel, however, the actual output is but one-sixth of the Far Eastern consumption. Herein lies the greatest metallurgical problem of eastern Asia, for the entire area is credited with but 3 per cent of the known iron ore reserves of the world. Since the present rate of consumption per capita is very low, there is hardly any danger of an iron famine for a century. The Philippine Islands and China lead in iron ore reserves, but in both cases the quality is poor.

The fifth part of the book is devoted to the economic factors of production and to world statistics of output and market prices.

The book is privately published in China and is not as creditable a piece of printing as can be done in that country. Unfortunately, there is no index, but there is a good bibliography.

GEORGE B. CRESSEY.

Angell, James W. *The Recovery of Germany.* 425 pages, Appendices, and Index. Published for the Council on Foreign Relations by the Yale University Press, New Haven. 1929.

The Recovery of Germany is an economic study made under the joint auspices of the Council of Foreign Relations and the Columbia University Council for Research in the Social Sciences. It is the outcome of the study and travel in Germany during the year 1928–1929, and is based on information gathered from conversation with many people in public and in private life, from personal observation made in the course of visits to over fifty factories and mines, and from statistical material.

As a foundation for the remainder of the book, eighty pages are given over to a concise but interesting review of the outstanding events between 1914 and 1924. Then by comparing and contrasting conditions in 1928 with those of 1913, the author indicates the progress that has been made in the six principal branches of German industry, the contrast that exists between the economic conditions of the industries and the people as a whole, and the trend of foreign trade; then after briefly outlining the outstanding features of the Young Plan points out the strength and the weaknesses of the nation as a whole, and makes some predictions as to the future.

The branches of German industry here analyzed—the coal, the iron and steel, the machinery, the electro-technical, the chemical, and the textile—employ nearly one-third of all the workers in industry, produce 40 per cent of the total manufactured products of the country, and 50 per cent of the total exports. In spite of the fact that one-third of Germany's coal reserves were ceded to France and Poland, she is now producing 85 per cent as much as she did in 1913, and is producing 9 per cent more than she did within her present boundaries in 1913. Although nearly three-fourths of her iron reserves, in addition to 20 per cent of her iron and steel working plants, were likewise lost, her present production is 80 per cent of what it was in 1913, and 15 per cent more than it was within her present boundaries at that time. Technically the German machine industry is in as good a condition as that of any other country in Europe, but financially it is not so satisfactory; a survey made in 1925 indicates that many of the firms were then earning only 1.4 per cent on the invested capital; since then business has improved somewhat and the average earnings probably run from 4 to 5 per cent. On the other hand the electro-technical industry is now one of the most prosperous industries in Germany, and the two big combines—the Siemens and the Allgemeine Elektrizitats-Gesellschaft—are paying from 8 to 14 per cent dividends. Similar rapid progress has been made by the chemical industry, and Germany is again one of the world's greatest exporters of chemical products, but instead of centering around coal tar products as it did before the war, the largest branch of the industry is engaged in the production of synthetic nitrate, chiefly the nitrate fertilizers. In contrast to the preceding industries, the textile industry which is by far the largest single industry in Germany—with the exception of the artificial silk branch—is as yet technically inferior to those of England and America although the financial condition as a whole is probably better than that in either England or America.

During this period of reorganization and progress of industry, agricultural production has been on the decline, and the physical volume of products is now, on the average, about 14 per cent less than it was within the present area in 1913. Nor has the improvement of the living conditions of the laboring people been as great as might be expected in comparison to the improve-

ment in industry. For labor in general, the average real wage was about 6 per cent higher in 1928 than in 1913. Unemployment, on an average, between 1924 and 1928, was 6 per cent greater than in the four years preceding the war. A somewhat similar situation exists as to her foreign commerce. Her share in world trade in 1928 was 9 per cent, as compared with 13 per cent in 1913; her exports in 1928 were only 19 per cent of her aggregate production in comparison to 25 per cent in 1913.

In considering Germany's future, among the elements of strength that Dr. Angell has listed are the possession of the largest coal reserves of any continental country, a laboring population whose willingness to work is unsurpassed, and the thorough reconstruction and reorganization of the basic industries; among the weaknesses are the failure to pass on to the ultimate consumer more of the gains made by the improvement of industry, the heavy cost of government, and above all the persistent depression of agriculture. After a careful analysis of the conflicting sets of elements, the conclusion is that Germany's expansion in industry will continue at a less spectacular rate than it has since 1924 but that it will be none the less genuine, and that in time Germany will again attain national strength and prosperity.

MARTHA ROBINS.

ANNOUNCEMENT

THE series on the *Agricultural Regions of the World* will be resumed in the January, 1931, issue with the first instalment of *Agricultural Regions of Asia* by Dr. Samuel Van Valkenburg of the College of the City of Detroit. Another instalment of *Agricultural Regions of North America* by Dr. O. E. Baker will also appear in the January issue. This will be followed in a later issue by *Agricultural Regions of Africa* by Homer L. Shantz, President of the University of Arizona, and will complete the finest geographic discussion of the world's agriculture thus far published.

To obtain the complete series of these extremely valuable articles, which present for the first time on such a comprehensive and accurate basis the significant divisions of the world's most important industry, it will be necessary to subscribe at once for ECONOMIC GEOGRAPHY, and date back to the October, 1926, issue.

In addition to this series of articles on agriculture, other series are being initiated; every issue will also contain four or five articles dealing with urban and regional geography, with problems of land utilization, with programs of development of resources, with commerce, with transportation, with health, and with the hundred and one other subjects that are of present geographic interest, all by the most competent and best informed authorities in their respective fields. ECONOMIC GEOGRAPHY is indispensable to the intelligent citizen.

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The July issue of Volume 6 contains the following articles:

Agricultural Regions of Australia, Griffith Taylor, University of Chicago.
The Pastoral and Agricultural Industries of Kenya Colony and Protectorate, Earl C. Case, University of Cincinnati.
Economic Adjustments in Bavaria, Hubert A. Bauer, University of Washington.
Agricultural Regions of North America, Oliver E. Baker, U. S. Dept. of Agriculture.
The Forest of Dean in Gloucestershire, E. Muriel Poggi, University of Illinois.

April includes:

Agricultural Regions of Australia, Griffith Taylor, University of Chicago.
Cane-Sugar Production in the British Empire, C. J. Robertson, St. Mary's Training College, Middlesex, England.
Rainfall and Wind Conditions Retarding Tropical Development, Stephen S. Visher, Indiana University.
Agricultural Regions of North America, Oliver E. Baker, U. S. Dept. of Agriculture.
Land Values in the Blue Grass and Nashville Basins, Raymond E. Murphy, University of Wisconsin.

January includes:

Agricultural Regions of South America, Clarence F. Jones, Clark University.
The Potato Industry in Nebraska, Esther S. Anderson, University of Nebraska.
Agriculture in the Dry Region of the U.S.S.R., N. M. Tulaikov, Agricultural Experiment Station, Saratov.
The German Sugar Beet Industry, E. Muriel Poggi, University of Illinois.
Divisions of the Pine Forest Belt of East Texas, William T. Chambers, Stephen F. Austin State Teachers College.

The October issue of Volume 5 contains the following articles:

Geography's Part in the Plant Cost of Iron and Steel Production at Pittsburgh, Chicago, and Birmingham, Langdon White, Randolph-Macon Woman's College.
Readjustments in Post-War Cotton Culture, Earl C. Case, University of Cincinnati.
Tung Oil: Florida's Infant Industry, M. Ogden Phillips, Formerly, University of Florida.
The Farm Problem, Robert Stewart, University of Nevada.
Forest Regeneration in Porto Rico, William D. Durland, Formerly, University of Porto Rico.
The Topographic Map of the United States, Guy Elliott Mitchell, U. S. Geological Survey.
Agricultural Regions of South America, Clarence F. Jones, Clark University.

July includes:

Canada's Advance to Hudson Bay, Harold S. Patton, University of Cincinnati.
Economic Conditions in St. Vincent, B. W. I., G. Wright, Imperial College of Tropical Agriculture, Trinidad.
Economic Geography of the Hawaiian Islands, Otis W. Freeman, State Normal School, Cheney, Washington.
Agricultural Regions of South America, Clarence F. Jones, Clark University.
Iron and Steel Industry of the Cleveland District, John B. Appleton, University of Illinois.

April includes:

Agricultural Regions of South America, Clarence F. Jones, Clark University.
The Potash Industry of Europe, Fred S. Mohme, University of Illinois.
The Sugar Industry of the British West Indies and British Guiana with Special Reference to Trinidad, C. Y. Shephard, Imperial College of Tropical Agriculture.
Iron and Steel Industry of the Middlesbrough District, John W. Frey, University of Wisconsin.
The Grape Industry of Spain and Portugal, W. O. Blanchard, University of Illinois, and Elizabeth R. Blanchard.
The Philippine Lumber Industry, Luis J. Borja.

Single copies of back numbers of Volumes 1 and 2, 1925 and 1926, will be sent to any American address for $1.75 each; to any foreign address for $2.00. Back numbers of Volume 3, 1927, Volume 4, 1928, Volume 5, 1929, and Volume 6, 1930, will be sent to any American address for $1.50 each; to any foreign address for $1.75. Whole volumes may be obtained at the yearly rate.

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INDEX

TO

VOLUME VI

ECONOMIC GEOGRAPHY

1930

ECONOMIC GEOGRAPHY

INDEX TO VOLUME VI

PAGE

Africa, Fluctuating Rainfall for Prominent Tropical Cities of (graph) ... 163
Agar, Flint, and Longwell, Geology from Original Sources (review) ... 423
Agricultural Crops, in Bavaria ... 262
Agricultural Land, of Tasmania (map) ... 126
Agricultural Methods, Land Tenure and, in North Andean Crops and Grazing Region of South America ... 14
Agricultural Organization, in Bavaria ... 263
Agricultural Pests, Distribution of, in Australia ... 216
Agricultural Production, of Australia ... 120
Agricultural Products, of Guianan Littoral of South America ... 23
  Minor Products ... 25
  Rice ... 25
  Sugar Cane ... 24
Agricultural Regions of Australia: Instalment I, Griffith Taylor (maps, tables, and illustrations) ... 109–135
  Instalment II, Griffith Taylor (maps, tables, and illustrations) ... 213–243
Agricultural Regions of Bavaria (map) ... 260
Agricultural Regions of North America: Part VIII—The Pacific Subtropical Crops Region, Oliver E. Baker (maps and illustrations) ... 166–191
  Part VIII—The Pacific Subtropical Crops Region (*Continued*), Oliver E. Baker (maps, tables, and illustrations) ... 278–309
Agricultural Regions of South America: Instalment VII, Clarence F. Jones (maps, graphs, and illustrations) ... 1–37
Agricultural Regions of South Australia ... 127
Agricultural Regions of Tasmania ... 126
Agricultural Regions of Victoria ... 125
Agricultural Regions of Western Australia ... 129
  Map of ... 130
Agricultural Regions, Summary of, in Australia ... 237
  Bush-Pasture ... 241
  Crop-Forest and Forest-Crop ... 239
  Crop-Pasture and Pasture-Crop Regions in Southeast ... 238
  Desert ... 242
  Desert-Pasture ... 242
  Forests ... 241
  Pasture ... 242
  Pasture-Bush ... 241
Agricultural Research in British Empire ... 142
Agriculture, Better Organization of, in the Dry Region of the U. S. S. R. ... 75
Agriculture, Climate and, of Kenya ... 243
Agriculture, Glacial Topography and, in Central Massachusetts, B. R. Millington (maps and illustrations) ... 408–416
Agriculture, in Crop-Forest and Forest-Crop Regions of Australia ... 239
Agriculture, in Crop-Pasture and Pasture-Crop Regions in Southeast of Australia ... 238
Agriculture in New South Wales ... 122
Agriculture in Queensland ... 122
Agriculture in the Dry Region of the U. S. S. R., N. M. Tulaikov (maps, tables, and illustrations) ... 54–81
Agriculture in Victoria, 1923–1924 (map) ... 125
Agriculture, Native, in Kenya ... 246
Agriculture, Native, Versus Plantation Agriculture, in Kenya ... 249
Agriculture, of Nevada ... 326
Agriculture, of North Andean Crops and Grazing Region of South America ... 5
  Cacao ... 7
  Coffee ... 5
  Cotton ... 8
  Low Altitude Subsistence Crops ... 10
  Sugar ... 9
  Temperate Crops ... 11
  Tobacco ... 9
Agriculture, of Utah ... 331
Agriculture and Commerce of Uganda, Earl C. Case (maps, graphs, and illustrations) ... 352–364
Agriculture and Land Values, in Pacific Subtropical Crops Region ... 183

PAGE

Air Marking (review) ... 107
Airports in Latin America, J. Warren Engle and Brower V. York (review) ... 416
Alcaraz, Eurique, Climatologia Agricola (review) ... 422
Alfalfa Acreage, 1919, in Pacific Subtropical Crops Region (map) ... 177
Almonds, Approximate Acreage of Pecans, Walnuts, and, 1919, in Pacific Subtropical Crops Region (map) ... 288
Analyses of Maryland Coals (review) ... 205
Anderson, Esther, Climatologia Agricola (review) ... 422
  The Potato Industry in Nebraska (maps, charts, tables, and illustrations) ... 37–54
Andrews, Roy Chapman, Ends of the Earth (review) ... 210
Angell, James W., The Recovery of Germany (review) ... 427
Animal Products, Changes in Production of, in Pacific Subtropical Crops Region ... 181
Animals, of North Andean Crops and Grazing Region of South America ... 12
Annual Report of Commissioner of Lighthouses to Secretary of Commerce for Fiscal Year Ended June 30, 1929 (review) ... 107
Annual Report of Director of Bureau of Foreign and Domestic Commerce to Secretary of Commerce for Fiscal Year Ended June 30, 1929 (review) ... 104
Area Under Crop, in Australia (table) ... 121
Arid Pastoral Country, of Australia ... 237
Asia, an Economic and Regional Geography, L. Dudley Stamp (review) ... 206
Asia, Fluctuating Rainfall for Prominent Tropical Cities of (graph) ... 155
Australia, Agricultural Regions of, Instalment I, Griffith Taylor (maps, tables, and illustrations) ... 109–135
  Instalment II, Griffith Taylor (maps, tables, and illustrations) ... 213–243
Australia, Acres Cultivated for Sugar Cane, 1923, in (map) ... 219
  Agricultural Production of ... 120
  Area under Crop in (table) ... 121
  Arid Pastoral Country of ... 237
  Average Annual Rainfall and Temperature of (map) ... 110
  Cattle in (graph) ... 231
  (Maps) ... 232, 233
  Cattle Tick in ... 218
  Dairy Farming in ... 232
  Distribution of Agricultural Pests in ... 216
  Distribution of Maize in (map) ... 223
  Drought in ... 236
  Dry Farming and Limits of Wheat Belt of ... 227
  General Environment of ... 109
  Great Artesian Basin of (maps) ... 131, 133
  Murrumbidgee Irrigation Scheme of ... 214
  Natural Vegetation of (maps) ... 114, 115
  Net Rainfall of (map) ... 227
  Oragraphical Map of ... 113
  Pastoral Industry in ... 230
  Population of (map) ... 117
  Prickly Pear Pest in ... 218
  Rain Reliability of (map) ... 112
  Rainfall Areas of (table) ... 230
  Rainfall Régime of ... 110
  Rainfall Regions of (map) ... 111
  Relation of Climate to Agriculture in (graph) ... 118
  Relative Importance of Crops in (table) ... 121
  Sheep in ... 234
  (Maps) ... 235, 236
  Soils of ... 213
  Special Conditions Affecting Agriculture in ... 130
  Spread of Cattle Tick, Rabbits (1859), Prickly Pear and Wild Dog in (map) ... 217
  Spread of Rabbit Pest in (map) ... 216
  Studies of Special Crops in ... 218
  Sugar Cane Production of, 1925 (map) ... 146
  Summary of Agricultural Regions in ... 237

Baker, Oliver E., Agricultural Regions of North America: Part VIII—The Pacific Subtropical Crops Region (maps and illustrations) ... 166–191
  Agricultural Regions of North America: Part VIII

PAGE

—The Pacific Subtropical Crops Region (*Continued*) (maps, tables, and illustrations) 278–309
Barley Acreage, 1919, in Pacific Subtropical Crops Region (map) 182
Barnes, Carleton P., Forests and Mankind (review) ... 419
The Structure and Life of Forest Trees (review) 421
Bauer, Hubert A., Economic Adjustments in Bavaria (maps and illustrations) 275–278
Bavaria, Adjustment to Soil in 261
Agricultural Crops in 262
Agricultural Organization in 263
Agricultural Regions of (map) 260
Cheap Labor of 270
Dairying in 263
Economic Adjustments in, Hubert A. Bauer (maps and illustrations) 257–278
Environmental Considerations of 257
Forestry in 264
Government Aid to Agriculture in 264
Historical Background of 259
Industrial Adjustments in 266
Land Utilization of 266
Location and Importance of Urban Centers of 274
Location and Physiographic Divisions of (map) 258
Minerals in 267
Politics in 273
Religion of 273
Scenery of 273
Science of 272
Water Power of 269
Bees, Colonies of, on Farms, January 1, 1920, in Pacific Subtropical Crops Region (map) 301
Beet Sugar, Production of, in Germany (graph) 91
(Chart) 93
Beet Sugar Factories, Distribution of, 1924–1928, in Germany (map) 89
Bengtson, Nels A., Geology from Original Sources (review) 423
Introduction to Historical Geology (review) 426
Blue Grass, Land Values in the, and Nashville Basins, Raymond E. Murphy (maps, charts, and illustrations) 191–204
Blue Grass Basin, Climate of 196
History of 198
Land Utilization of 198, 200
Land Values in the (map) 193
Location of 197
Maps of 192, 194
Physiography and Topography of 191
Size of 193
Soil of 194
Tobacco Production, 1924, in (map) 201
Utilization of Crop Land, Harvested in 1924, in (chart) 200
Value of Crops, Per Acre of Crop Land for 1924, in (map) 202
Bogardus, J. F., The Great Basin (illustrations) 312–338
Boundaries, in Pacific Subtropical Crops Region..... 169
Boundaries, of the Dry Region of the U. S. S. R..... 54
Bowie Method of Triangulation Adjustment, The, Oscar S. Adams (review) 205
Bratton, Sam T., Land Utilization in the St. Francis Basin (maps, graphs, tables, and illustrations).. 374–389
Brazil Nuts, of Region of Amazonian Forest and Primitive Agriculture of South America 34
Britain, The Physiographical Evolution of, L. J. Mills (review) 210
British Cane-Sugar Industry, Labour in 140
Soil in 139
British Empire, Cane-Sugar Production in the, C. J. Robertson (maps, graphs, tables, and illustrations) 135–152
British Empire, Agricultural Research in 142
Classification of Cane-Sugar Producing Countries of 143
Conditions of Cane-Sugar Production in 138
Development of Raw Sugar Factory in 143
Production of Raw-Cane Sugar in (table) 138
Sugar Production, 1915–1916 to 1926–1927, in (graph) 136
Sugar Production in Certain Countries of (chart) ... 138
British Raw Sugar Imports, Sources of, 1922–1926 (graph) 136
British Trade in Rubber and Rubber Products (review) 105
British West Indies, Average Export of Sugar, Rum, and Molasses from, 1922–1926 (table) 149
Burhans, N. C., Introduction to Agricultural Economics (review) 419
Burrill, Meredith F., The Physiographical Evolution of Britain (review) 210
Büsgen, M., and Münch, E., The Structure and Life of Forest Trees (review) 421

PAGE

Cacao, in North Andean Crops and Grazing Region of South America 7
California Commercial Vegetable Crops, Trend of Carlot Shipments of, in Recent Years and Farm Value of Crop in 1928 (table) 287
Cane-Sugar Producing Countries, Classification of, in British Empire 143
British West Indies 146
Fiji 145
India 149
Mauritius 144
Cane-Sugar Production, Conditions of, in British Empire 138
Cane-Sugar Production in the British Empire, C. J. Robertson (maps, graphs, tables, and illustrations) 134–152
Cantaloupes and Muskmelons, Acreage of, 1919, Grown for Sale, in Pacific Subtropical Crops Region (map) 291
Capital, Concentration of, and Labor, on Better Land in Pacific Subtropical Crops Region 180
Carlot Shipments, Increase of, of Vegetables from Lower Rio Grande Valley of Texas (chart) 367
Carlson, Fred A., C. C. Huntington and, Environmental Basis of Social Geography (review) 209
Case, Earl C., Agriculture and Commerce of Uganda (maps, graphs, and illustrations) 352–364
The Pastoral and Agricultural Industries of Kenya Colony and Protectorate (maps, charts, and illustrations) 243–257
Cattle, Distribution of, in South America (map) 22
Cattle, in Australia 231
(Graph) 231
(Maps, 1923) 232, 233
Cattle-Grazing Industry, of Llanos Grazing Region of South America 19
Cattle Raising in Argentina (review) 105
Cattle Tick, in Australia 218
Spread of, Rabbits (1859), Prickly-Pear and Wild Dog, in Australia (map) 217
Central Climatic District of Nebraska, Average Temperature and Total Rainfall, May to August, and the Average Yield per Acre in the, 1917, 1927 (table) 43
Central Massachusetts, Glacial Topography and Agriculture in, B. R. Millington (maps and illustrations) 408–416
Central Region, of Nebraska 43
Cereal Belt, of Kenya 255
Of Uganda 357
Chambers, William T., Lower Rio Grande Valley of Texas (maps, charts, and illustrations) 364–374
Characteristics, Principal, of the Volga Area and Adjacent Lands of the U. S. S. R. 57
Climate 58
Soil 57
Chief Crops, Acreage of, in Germany (graph) 84
Per Cent of World Total of, in Germany (chart) .. 84
Citrus Fruit and Pear Trees, Approximate Acreage of, 1919, in Pacific Subtropical Crops Region (map) 282
Citrus Fruit Industry, of Lower Rio Grande Valley of Texas 367
Climate, of Blue Grass and Nashville Basins 196
Of Guianan Littoral of South America 23
Of North Andean Crops and Grazing Region of South America 2
Of Pacific Subtropical Crops Region 170
Of Region of Amazonian Forest and Primitive Agriculture of South America 31
Of the Volga Area and Adjacent Lands of the U. S. S. R. 58
Relation of, to Agriculture, in Australia (graph) ... 118
Climate and Agriculture, of Kenya 243
Climatologia Agricola, Eurique Alcaraz (review) 422
Coal Mining, in Forest of Dean in Gloucestershire 315
Coffee, Acreage and Production of, and sisal, in Kenya (chart) 249
Coffee, and Rubber Culture, in Uganda 362
Coffee, in North Andean Crops and Grazing Region of South America 5
Coffee Industry of Brazil, The, Walter Gay McCreery and Mary L. Bynum (review) 416
Coffee Production, in North Andean Crops and Grazing Region of South America (map) 7
Coffee-Sisal Belt, of Kenya 252
Colombia, Mountain Tops and Lowlands of, Albert C. Smith (illustrations) 398–408
Commerce, Agriculture and, of Uganda, Earl C. Case (maps, graphs, and illustrations) 352–364
Commerce Yearbook, 1929, Volumes I and II (review) 104
Commercial Crops, of Uganda 359
Coffee and Rubber Culture 362
Cotton the Major Commercial Crop 360

PAGE

Conditions, Amelioration of, in the Dry Region of the U. S. S. R. 79
Cotton Ginned in Counties in Lower Rio Grande Valley of Texas (chart) 377
Cotton, in North Andean Crops and Grazing Region of South America 8
In Queensland (map) 221
The Major Commercial Crop, of Uganda 360
Cotton Crop, The, of Lower Rio Grande Valley of Texas 370
Cotton Culture and Social Conditions, in Uganda 361
Cotton Growing District, of the St. Francis Basin 376
Cressey, George B., Asia, An Economic and Regional Geography (review) 206
Ethnography (review) 422
Human History (review) 422
The Mineral Industry of the Far East (review) 426
Crop Failure, Causes of, in the Volga Area of the U. S. S. R. 65
Crop Land, Utilization of, Harvested in 1924, in Blue Grass and Nashville Basins (chart) 200
Crop Practices and Drought, in the Dry Region of the U. S. S. R. 64
Crop Regions, of Kenya (map) 247
Crop Rotations Used in Sugar Beet Culture in Germany (table) 88
Crops, Acreage of Principal, in Uganda (graph) 356
Crops, Average Annual Value per Acre of the Principal, in Nebraska, 1919–1927 (graph) 50
Relative Importance of, in Australia (table) 121
Value of, per Acre, of Crop Land, for 1924, in Blue Grass and Nashville Basins (map) 202
Cross-section of Forest of Dean in Gloucestershire (chart) 312
Cultivated Crops, of Region of Amazonian Forest and Primitive Agriculture of South America 35
Cultivated Land, 1923, in New South Wales (table) 124
Cultivated Land in New South Wales (map) 124
Cultivated Land in Queensland, 1921 (map) 121
Cultivated Land in South Australia, 1923 (map) 127
Current Business, Survey of, February, 1930 (review) 204
Cyclones, Other Indirect Effects of Tropical 163
Tracks of Tropical (map) 159
Czecho-Slovakia, Sugar Exports of Germany and (graph) 92

Dairy Cattle, January 1, 1920, in Pacific Subtropical Crops Region (map) 293
Dairy Farming, in Australia 232
Dairying, in Bavaria 263
Davis, Joseph Stancliffe, The Farm Export Debenture Plan (review) 420
Distances Between United States Ports (review) 205
Districts and Areas Cultivated, in Queensland (table) 122
Divisions of the Pine Forest Belt of East Texas, William T. Chambers (maps and illustrations) 94–104
Douglass, Harlan Paul, The Suburban Trend (review) 208
Dried Fruit Industry and Trade of South Africa, Cecil M. P. Cross (review) 205
Drought, and the Crops in the Dry Region of the U. S. S. R. 62
Drought, Characteristics of, in the Dry Region of the U. S. S. R. 61
In Australia 236
Measures for Overcoming the, in the Dry Region of the U. S. S. R. 68
Dry Farming and the Limits of the Wheat Belt of Australia 227
Dry Region of the U. S. S. R., Agriculture in the, N. M. Tulaikov (maps, tables, and illustrations) 54–81
Dry Region of the U. S. S. R., Amelioration of Conditions in the 79
Better Organization of Agriculture in the 75
Boundaries of the 54
Characteristics of Drought in the 61
Crop Practices and Drought in the 64
Drought and the Crops in the 62
Improved Technique of Tillage in the 69
Map of 55
Measures for Overcoming the Drought in the 68
Plant Selection in the 74
Role of Land Settlement in the 79
Stock Raising in the 79

Early History, of Lime Industry at Rockland, Maine 389
East Texas, Divisions of the Pine Forest Belt of, William T. Chambers (maps and illustrations) 94–104
Economic Adjustments in Bavaria, Hubert A. Bauer (maps and illustrations) 257–278
Editorials: Australia opp. p. 109
Plateaus opp. p. 213
Sugar opp. p. 1
Eesti. Kodu-uurimise töö, J. Rumma, J. G. Grano, and J. V. Veski (review) 421

PAGE

Ekblaw, W. Elmer, Environmental Basis of Social Geography (review) 209
Employment for Americans in Latin America, Fifth Edition (review) 9
Ends of the Earth, Roy Chapman Andrews (review) 418
England and Wales, Map of, Showing Location of Forest of Dean in Gloucestershire (map) 210
Environmental Basis of Social Geography, C. C. Huntington and Fred A. Carlson (review) 310
Environmental Considerations of Bavaria 209
Environmental Factors Affecting Potato Production in Nebraska 257
Ethnography, Loomis Havemeyer (review) 37
Europe, Margarine Industry of, E. L. Thomas (review) 422
European Plantation Agriculture 205
European Settlements, in Kenya Colony 251
Exports, Principal, of Kenya (map) 252
247

Farm Export Debenture Plan, The, Joseph Stancliffe Davis (review) 420
Farming, Systems of, in Pacific Subtropical Crops Region 294
Farms, Size and Tenure of, in Pacific Subtropical Crops Region 299
Field Beans and Peanuts, Acreage of, 1919, in Pacific Subtropical Crops Region (map) 188
Field Crops, in Pacific Subtropical Crops Region 186
Finch, Grant E. and Howe, George F., The Lime Industry at Rockland, Maine (maps and illustrations) 389–398
Finland: An Economic Review, Alvin C. Eichholz and Herbert Rodeck (review) 416
Fishery Industries of the United States, 1928, R. H. Fiedler (review) 205
Flint, Agar, and Longwell, Geology from Original Sources (review) 423
Flowers, Garden Seeds and, in Pacific Subtropical Crops Region 288
Foodstuffs, Markets of, in Guatemala, H. P. Macgowan (review) 205
Foreign Trade in Fresh Fruits, Daniel J. Moriarty (review) 204
Foreign Trade of the United States, in the Calendar Year 1929, Grace A. Witherow (review) 416
Forest of Dean in Gloucestershire, The, E. Muriel Poggi (maps and illustrations) 309–320
Forest of Dean in Gloucestershire, Coal Mining in 315
Cross-Section of (chart) 312
Distribution of Population in 317, 318
Geological Map of 311
Industry of 310
Iron Mining in 312
Map of 310
Stone Quarrying in 317
Structure of 309
Timber 315
Topographical Map of 310
Tuft's Level in (chart) 312
Forest Industries, in the Guianan Forest and Grazing Region of South America 28
Forest Industries, Minor, of Region of Amazonian Forest and Primitive Agriculture of South America 35
Forestry, in Bavaria 264
Forests, in Utah 334
Forests and Mankind, Charles Lathrop Pack and Tom Gill (review) 419
Fort Hall, Rainfall of, by Months, in Kenya (chart) 246
Freezing Temperatures, Frequency and Severity of, at Stations in Citrus-Producing Areas in California, Florida, and Texas 369
Fresh Fruits, Foreign Trade in, Daniel J. Moriarty (review) 204
"Fruit Acres," Stow, Massachusetts 412
Development of Orchards at 413
Fruit Markets in Eastern Asia (review) 418
Fruits and Nuts, in Pacific Subtropical Crops Region 278
Map of 279
Fruits and Vegetables, Increase in, in Pacific Subtropical Crops Region 182
Fuel, Importation of, for Lime Industry of Rockland, Maine 391
Fuel-Oil Burners, Markets for, in the Eastern Hemisphere (review) 205
Future, of Guianan Forest and Grazing Region of South America 30
Of Guianan Littoral of South America 26
Of North Andean Crops and Grazing Region of South America 17
Future Utilization of the Pine Forest Belt of East Texas 103

PAGE

Garden Seeds and Flowers, in Pacific Subtropical Crops Region ... 288
General Environment of Australia ... 109
Generalized Table, Showing Crops Grown in Districts in Victoria (table) ... 126
Geography, A New Regional, of the World, Marion I. Newbigin (review) ... 211
Geological Map, of Forest of Dean in Gloucestershire 311
Geology from Original Sources, Agar, Flint, and Longwell (review) ... 423
German Beet Sugar Production (chart) ... 93
German Sugar Beet Industry, The, E. Muriel Poggi (maps, graphs, tables, and illustrations) ... 81–94
Germany, Acreage of Chief Crops in (graph) ... 84
Crop Rotation Used in Sugar Beet Culture in (table) 88
Distribution of Beet Sugar Factories, 1924–1928 in (map) ... 89
Per Cent of World Total of Chief Crops in (chart) ... 84
Production of Beet Sugar in (graph) ... 91
(Chart) ... 93
Production of Sugar Beet, 1925, in (map) ... 87
Sugar Exports of, and Czecho-Slovakia (graph) ... 92
Gill, Tom; Pack, Charles Lathrop and, Forests and Mankind (review) ... 419
Glacial Topography and Agriculture in Central Massachusetts, B. R. Millington (maps and illustrations) ... 408–416
Gloucestershire, The Forest of Dean in, E. Muriel Poggi (maps and illustrations) ... 309–320
Government Aid to Agriculture, in Bavaria ... 264
Grano, J. G., Rumma, J., and Veski, J. B., Eesti. Kodu-uurimise töö (review) ... 421
Grapevines, of All Ages, 1924, in Pacific Subtropical Crops Region (map) ... 280
Grazing, in the Guianan Forest and Grazing Region of South America ... 28
Great Artesian Basin, of Australia ... 131
Map of ... 133
Great Basin, The, J. F. Bogardus (illustrations) ... 321–338
Great Basin, Physiography of ... 322
Resources and Industries of ... 325
Transportation in ... 335
Great Britain, Imports of Raw Sugar into (table) ... 135
Imports of Raw Sugar to, from British Empire (table) ... 137
Great Britain's Sugar Supply ... 135
Gregory, Elizabeth, Old Civilizations of the New World (review) ... 425
Guatemala, Markets of Foodstuffs in, H. P. Macgowan (review) ... 205
Guianan Forest and Grazing Region, The, of South America ... 27
Forest Industries of ... 28
Future of ... 30
Grazing in ... 28
Physical Setting in ... 27
Guianan Littoral, The, of South America ... 21
Agricultural Products of ... 23
Climate of ... 23
Future of ... 26
Surface of the Land in ... 23

Hamburg, Port of, Ralph I. Schneider (review) ... 204
Harper, Roland M., A Map of the World's Drugs (review) ... 107
Havemeyer, Loomis, Ethnography (review) ... 422
Hay, Small Grains Cut for, Acreage, 1919, in Pacific Subtropical Crops Region (map) ... 180
Historical Background, of Bavaria ... 259
History, of Blue Grass and Nashville Basins ... 198
Howe, George F., Finch, Grant E. and, The Lime Industry at Rockland, Maine (maps and illustrations) ... 389–398
Hudgins, Bert, Economic Resources and Industries of the World (review) ... 206
Human History, G. Elliot Smith (review) ... 422
Huntington, C. C. and Carlson, Fred A., Environmental Basis of Social Geography (review) ... 209
Hurricanes and the Race Problem, in the Tropics ... 164
Hutter, Harry K., The Suburban Trend (review) ... 209
Hydrography, A. L. Shalowitz (review) ... 418

Index to Commerce Reports, Nos. 26–39, Volume 3, Thirty-Second Year, July-September, 1929 (review) ... 104
Index to Commerce Reports, Nos. 1–13, Volume 1, Thirty-Third Year, January-March, 1930 (review) ... 418
Industrial Adjustments, in Bavaria ... 266
Industrial Structure of New England, Charles E. Artman (review) ... 416
Industrialism, Raw Materials of, Hugh B. Killough and Lucy W. Killough (review) ... 207
Industries, Resources and, of the Great Basin ... 325

PAGE

Industry, of Forest of Dean in Gloucestershire ... 310
Inland-Waterway Freight Transportation Lines in the United States, L. P. Nickell and W. S. Abernathy (review) ... 416
Installment Selling of Automobiles in Oceania, Asia, and Africa (review) ... 417
Instructions, Primary Tide Stations (review) ... 107
Introduction to Agricultural Economics, F. R. Yoder (review) ... 419
Introduction to Historical Geology, W. J. Miller (review) ... 426
Irrigated Land, Approximate Location and Extent of, in Pacific Subtropical Crops Region (map) ... 174
Irrigation, in Victoria ... 215
Map of ... 216
Iron Mining, in Forest of Dean in Gloucestershire ... 312

Jones, Clarence F., Agricultural Regions of South America: Instalment VII (maps, graphs, and illustrations) ... 1–37
South America (review) ... 424

Kenya, Acreage and Production of Coffee and Sisal in (chart) ... 249
Cereal Belt of ... 255
Climate and Agriculture of ... 243
Coffee-Sisal Belt of ... 252
Crop Regions of (map) ... 247
Mixed Farming Area of ... 256
Native Agriculture in ... 246
Native Agriculture Versus Plantation Agriculture in ... 249
Native Pastoral Industry of ... 249
Native-Owned Livestock of, 1926 (table) ... 250
Necessity of Railway Communication in ... 251
Pastoral Zone of ... 256
Place Map of ... 244
Principal Exports of (map) ... 247
Rainfall Map of ... 244
Sisal of ... 254
Kenya Colony, European Settlements in ... 252
Kenya Colony and Protectorate, The Pastoral and Agricultural Industries of, Earl C. Case (maps, charts, and illustrations) ... 243–257
Killough, Hugh B. and Killough, Lucy W., Raw Materials of Industrialism (review) ... 207

Labor, Change from Native to Foreign, in Lime Industry of Rockland, Maine ... 391
Assimilation of Certain Classes of Foreigners ... 393
Labor, Changes in Efficiency of, in Pacific Suptropical Crops Region ... 184
Cheap, of Bavaria ... 270
Concentration of Capital and, on Better Land in Pacific Subtropical Crops Region ... 180
Expenditure for, During 1919, in Pacific Subtropical Crops Region (map) ... 304
Labour, in British Cane-Sugar Industry ... 140
Labour Factor, Critical Importance of, in Mauritius Sugar Industry ... 344
Lamu, Rainfall of, by Months, in Kenya (chart) ... 246
Land, Surface of the, in Guianan Littoral of South America ... 23
Use of, Not in Farms in St. Francis Basin ... 384
Land in Farms, Use of the, in the St. Francis Basin ... 375
Land Settlement, Role of, in the Dry Region of the U. S. S. R. ... 79
Land Tenure and Agricultural Methods, in North Andean Crops and Grazing Region of South America ... 14
Land Utilization, in Bavaria ... 266
Land Utilization in the St. Francis Basin, Sam T. Bratton (maps, graphs, tables, and illustrations) ... 374–389
Land Utilization, of Blue Grass and Nashville Basins 200
Map of ... 198
Land Utilization, of Pacific Suptropical Crops Region 179
Agriculture and Land Values ... 183
Changes in Efficiency of Labor ... 184
Changes in Production of Animal Products ... 181
Concentration of Capital and Labor on Better Land 180
Field Crops ... 186
Fruits and Nuts ... 278
Garden Seeds and Flowers ... 288
Increase in Fruits and Vegetables ... 182
Shifts in Systems of Farming ... 181
Vegetables ... 285
Land Utilization on One Square Mile in the Mixed Farming District, near Sikeston, Missouri (chart) 381
Land Utilization on One Square Mile in the Risco Mixed Farming District in the St. Francis Basin (chart) ... 384
Land Values, Agriculture and, in Pacific Subtropical Crops Region ... 183

PAGE

Land Values in the Blue Grass and Nashville Basins, Raymond E. Murphy (maps, charts, and illustrations) ... 191–204
Map of ... 193
Lead Production, Summarized Data of, Lewis A. Smith and Others (review) ... 205
Leather Trade of Egypt (review) ... 105
Lime Industry at Rockland, Maine, The, Grant E. Finch and George F. Howe (maps and illustrations) ... 389–398
Lime Industry at Rockland, Maine, Change from Native to Foreign Labor in ... 391
Early History of ... 389
Importation of Fuel for ... 391
Methods of Transportation in ... 394
Lippincott, Isaac, Economic Resources and Industries of the World (review) ... 206
Liverpool, Port of, Including Birkenhead and Garston, Edward P. Cotter (review) ... 204
Livestock, In Pacific Subtropical Crops Region ... 289
In Region of Amazonian Forest and Primitive Agriculture of South America ... 35
Native-Owned, of Kenya, 1926 (table) ... 250
Of Nevada ... 327
Of Utah ... 332
Llanos Grazing Region, of South America ... 17
Cattle Grazing Industry of ... 19
Outlook of ... 21
Physical Conditions of ... 18
Local Topography and Agriculture of Stow, Massachusetts, Area ... 411
Drumlin Area ... 411
Sand-Plain ... 411
Location, of Blue Grass and Nashville Basins ... 197
Location and Importance of Urban Centers, of Bavaria ... 274
Location and Physiographic Divisions of Bavaria (map) ... 258
Longwell, Agar, Flint, and, Geology from Original Sources (review) ... 423
Lower Rio Grande Valley of Texas, William T. Chambers (maps, charts, and illustrations) ... 364–374
Lower Rio Grande Valley of Texas, Citrus Fruit Industry of ... 367
Cotton Crop of ... 370
Cotton Ginned in Counties in (chart) ... 377
Early Vegetable Crops of ... 364
Increase of Carlot Shipments of Vegetables from (chart) ... 367
Map of ... 365
Ranching Industry of ... 370
Regional Problems of ... 371
Shipments of Leading Vegetable Crops from (chart) ... 368

Maize, in Australia ... 222
Distribution of, in Australia (map) ... 223
Maize and Wheat Acreage and Production, of Kenya (chart) ... 250
Major Field Crops, Comparative Net Values of the, in the St. Francis Basin (table) ... 378
Manual of First-Order Leveling, Henry G. Avers (review) ... 107
Manufacturing, in Nevada ... 329
In Utah ... 335
Map of the World's Drugs, A, National Druggists' Association (review) ... 107
Margarine Industry of Europe, The, E. L. Thomas (review) ... 205
Market, Influence of Sugar, of Mauritius ... 348
Market Data Handbook of the United States, The, Paul W. Stewart (review) ... 204
Marketing of Nickel, The, J. W. Furness (review) ... 417
Marketing of Tungsten Ores and Concentrates (review) ... 105
Markets for Building Materials: Part II, Mexico, Central America, and West Indies (review) ... 104
Markets of Foodstuffs in Guatemala, The, H. P. Macgowan (review) ... 205, 417
Markets for Fruit Juices and Fruit Sirups in Continental Europe, John A. Embry (review) ... 416
Markets for Fuel-Oil Burners in the Eastern Hemisphere (review) ... 205
Markets for Sawmill and Woodworking Machinery in Mexico, Guatemala, Panama, Cuba, and Porto Rico (review) ... 205
Markets for Sawmill and Woodworking Machinery in Scandinavia and the Baltic States, T. O. Klath (review) ... 417
Markets for Sawmill and Woodworking Machinery in South America, Charles H. Ducote (review) ... 417
Markets, Principal, for Nebraska Potatoes (map) ... 49
Maryland Coals, Analyses of (review) ... 205

PAGE

Mauritius, The Sugar Industry of, C. J. Robertson (maps, charts, and illustrations) ... 338–352
Mauritius, Development of Sugar Production in ... 347
Distribution of Sugar Cane in ... 338
Influence of Sugar Market of ... 348
Position of, as a One-Crop Country ... 350
Precipitation in (chart) ... 339
Relation of Growth of Sugar Cane to Climatic Conditions in ... 338
Relation of Growth of Sugar Cane to Temperature in (chart) ... 340
Sugar Exports of, 1884–1926 (graph) ... 140
Sugar Production in, 1920–1924 (map) ... 339
(chart) ... 343
Tonnage of Sugar Cane per Arpent on Estates in (chart) ... 347
Mauritius Sugar Industry, Critical Importance of Labour Factor in ... 344
Soils of ... 342
Millet Culture, Distribution of, in Uganda (map) ... 355
Miller, W. J., Introduction to Historical Geology (review) ... 426
Millington, B. R., Glacial Topography and Agriculture in Central Massachusetts (maps and illustrations) ... 408–416
Milstead, Harley P., South America (review) ... 424
Mineral Industry of the Far East, The, Boris P. Torgasheff (review) ... 426
Minerals, in Bavaria ... 267
Mining, in Nevada ... 328
Mining and Quarrying, in Utah ... 333
Mixed Farming Area, of Kenya ... 256
Mixed Farming District, of the St. Francis Basin ... 380
Molasses, Average Export of, from British West Indies, 1922–1926 (table) ... 149
Mombasa, Rainfall of, by Months, in Kenya (chart) ... 245
Monthly Summary of Foreign Commerce of United States, July, August, and September, 1929 (review) ... 104
Motorization of North Africa, The, H. C. Schuette (review) ... 416
Mountain Tops and Lowlands of Colombia, Albert C. Smith (illustrations) ... 398–408
Münch, E., Büsgen, M. and, The Structure and Life of Forest Trees (review) ... 421
Murphy, Raymond E., Land Values in the Blue Grass and Nashville Basins (maps, charts, and illustrations ... 191–204
Murrumbidgee Irrigation Scheme of Australia ... 214
Muskmelons, Acreage of Cantaloupes and, 1919, Grown for Sale, in Pacific Subtropical Crops Region (map) ... 291

Nashville Basin, Climate of ... 196
History of ... 198
Land Utilization of ... 198, 200
Land Values in the (map) ... 193
Location of ... 197
Maps of ... 192, 194
Physiography and Topography of ... 191
Size of ... 193
Soil of ... 194
Tobacco Production, 1924, in (map) ... 201
Utilization of Crop Land, Harvested in 1924, in (chart) ... 200
Value of Crops, per Acre of Crop Land for 1924, in (map) ... 202
Nashville Basins, Land Values in the Blue Grass and, Raymond E. Murphy (maps, charts, and illustrations) ... 191–204
Natal, Sugar Cane Production of (map) ... 141
National Druggists' Association, A Map of the World's Drugs (review) ... 107
Natural Vegetation, of Australia (map) ... 114, 115
Nebraska, The Potato Industry of Nebraska, Esther S. Anderson (maps, graphs, tables, and illustrations) ... 37–54
Nebraska, Average Annual Potato Production, 1919–1927, bushels in (map) ... 38
Average Annual Value per Acre of the Principal Crops in, 1919–1927 (graph) ... 50
Average Annual Yield of Potatoes, Bushels, per Acre in the Three-Soil Regions of, 1917–1927 (table) ... 47
Central Region of ... 43
Environmental Factors Affecting Potato Production in ... 37
Normal Isotherms of, June 1 to September 30 (map) ... 38
Regions of Production of Potatoes in ... 37
Response of Potato Production in, to Climatic Conditions ... 37
Western Region of ... 39

PAGE

Nebraska Certified Seed Potatoes ... 47
Production of (graph) ... 48
Nebraska Potatoes, Principal Markets for (map) ... 49
Production and Value of ... 50
Shipping Center for ... 51
Nevada, Agriculture of ... 326
Livestock of ... 327
Manufacturing in ... 329
Mining in ... 328
Population of ... 326
Size and General Characteristics of ... 325
Newbigin, Marion I., A New Regional Geography of the World (review) ... 211
New South Wales, Agriculture in ... 122
Almost Uninhabited Regions in Humid (map) ... 134
Cultivated Land, 1923, in (table) ... 124
Cultivated Land in (map) ... 124
Normal Isotherms of Nebraska, June 1 to September 30 (map) ... 38
North America, Agricultural Regions of: Part VIII—The Pacific Subtropical Crops Region, Oliver E. Baker (maps and illustrations) ... 166–191
Part VIII—The Pacific Subtropical Crops Region (*Continued*), Oliver E. Baker (maps and illustrations) ... 278–309
North America, Fluctuating Rainfall for Prominent Tropical Cities of (graph) ... 158
North Andean Crops and Grazing Region of South America ... 1
Agriculture of ... 5
Animals of ... 12
Coffee Production in (map) ... 7
Future of ... 17
Land Tenure and Agricultural Methods in ... 14
Physical Conditions of ... 1
Northeast Texas Agricultural Region ... 98
Northwestern Climatic District of Nebraska, Average Temperature and Rainfall, June to September, and the Average Yield per Acre in the, 1917–1927 (table) ... 40
Nuts, Fruits and, in Pacific Subtropical Crops Region ... 278

Ocean Routes in United States Foreign Trade, A. Lane Cricher (review) ... 416
Old Civilizations of the New World, A. Hyatt Verrill (review) ... 425
Orographical Map, of Australia ... 113
Osceola, Arkansas, Rainfall Record of (graph) ... 376
Sunshine Record of (graph) ... 376
Outlook, of Agriculture and Commerce of Uganda ... 363
Of Llanos Grazing Region of South America ... 21
Of Region of Amazonian Forest and Primitive Agriculture of South America ... 35

Pacific Localities, Fluctuating Rainfall for (graph) ... 161
Pacific Subtropical Crops Region, Acreage of Alfalfa in (map) ... 177
Acreage of Barley, 1919, in (map) ... 182
Acreage of Cantaloupes and Muskmelons, 1919, Grown for Sale in (map) ... 291
Acreage of Field Beans and Peanuts, 1919, in (map) ... 188
Acreage of Small Grains Cut for Hay, 1919, in (map) ... 180
Acreage of Vegetables Grown for Sale, 1919, in (map) ... 290
Approximate Acreage of Citrus Fruits and Pear Trees, 1919, in (map) ... 282
Approximate Acreage of Pecans, Walnuts, and Almonds, 1919, in (map) ... 288
Approximate Location and Extent of Irrigated Land in (map) ... 174
Average Annual Precipitation of (map) ... 172
Colonies of Bees, on Farms, January 1, 1920, in (map) ... 301
Dairy Cattle, January 1, 1920, in (map) ... 293
Expenditure for Labor, During 1919, in (map) ... 304
Fruits and Nuts in (map) ... 279
Grapevines, of All Ages, 1924, in (map) ... 280
Land Utilization in ... 179
Livestock in ... 289
Map of ... 167
Pastures in ... 288
Peach Production, 1919, in (map) ... 286
People in ... 302
Physical Conditions of ... 169
Size and Tenure of Farms in ... 299
Systems of Farming in ... 294
Vegetation in (map) ... 170
Pacific Subtropical Crops Region Farms, Classified by Area, 1925 (table) ... 300
Pack, Charles Lathrop, and Gill, Tom, Forests and Mankind (review) ... 419

PAGE

Pastoral Belt, of Uganda ... 359
Pastoral Industry in Australia ... 230
Pastoral Industry, Native, in Kenya ... 249
Pastoral Zone, of Kenya ... 256
Pastoral and Agricultural Industries of Kenya Colony and Protectorate, The, Earl C. Case (maps, charts, and illustrations) ... 243–257
Pastures, in Pacific Subtropical Crops Region ... 288
Peach Production, 1919, in Pacific Subtropical Crops Region (map) ... 286
Peanuts, Acreage of Field Beans and, 1919, in Pacific Subtropical Crops Region (map) ... 188
Pear Trees, Approximate Acreage of Citrus Fruits and, 1919, in Pacific Subtropical Crops Region (map) ... 282
Pecans, Walnuts, and Almonds, Approximate Acreage of, 1919, in Pacific Subtropical Crops Region (map) ... 288
People, of Pacific Subtropical Crops Region ... 302
Education ... 303
Illiteracy ... 305
Nations and Races ... 303
Religion ... 305
Trend of Population ... 306
Physical Conditions, of Llanos Grazing Region of South America ... 18
Physical Conditions, of North Andean Crops and Grazing Region of South America ... 1
Climate ... 2
Relief ... 2
Vegetation ... 4
Physical Conditions, of Pacific Subtropical Crops Region ... 169
Boundaries ... 169
Climate ... 170
Soils ... 176
Topography ... 175
Physical Conditions, of Region of Amazonian Forest and Primitive Agriculture of South America ... 31
Climate ... 31
Relief and Soils ... 33
Vegetation ... 32
Physical Setting, in the Guianan Forest and Grazing Region of South America ... 27
Physiographical Evolution of Britain, The, L. G. Wills (review) ... 210
Physiography, of the Great Basin ... 322
Physiography and Topography, of Blue Grass and Nashville Basins ... 191
Pine Forest Belt of East Texas, Divisions of the, William T. Chambers (maps and illustrations) ... 94–104
Pine Forest Belt of East Texas, Future Utilization of the ... 103
Geographic Regions in the (map) ... 95
Piney Woods Region of ... 94
Piney Woods Region, of Pine Forest Belt of East Texas ... 94
Place Map of Uganda ... 353
Plant Selection, in the Dry Region of the U. S. S. R. ... 74
Plantain Belt, The, of Uganda ... 355
Plantain Culture, Distribution of, in Uganda (map) ... 355
Plantation Agriculture of Europeans in Uganda ... 362
Poggi, E. Muriel, The Forest of Dean in Gloucestershire (maps and illustrations) ... 309–320
The German Sugar Beet Industry (maps, graphs, tables, and illustrations) ... 81–94
Politics, of Bavaria ... 273
Population, Distribution of, in Forest of Dean in Gloucestershire ... 317
(Chart) ... 318
Population, of Australia ... 117
Map of ... 117
Population, of Nevada ... 326
Of Utah ... 330
Population, Total, and Estimated Farm Population, 1850–1924, in California (table) ... 307
Port of Hamburg, The, Ralph I. Schneider (review) ... 204
Port of Liverpool, Including Birkenhead and Garston, The, Edward P. Cotter (review) ... 204
Port Studies in Coöperation Between the Bureau of Foreign and Domestic Commerce and U. S. Shipping Board (review) ... 204
Potato Industry, in Nebraska, The, Esther S. Anderson (maps, graphs, tables, and illustrations) ... 37–54
Potato Production, Average Annual, 1919–1927, Bushels, in Nebraska (map) ... 38
Response of, in Nebraska, to Climatic Conditions ... 37
Summer Rainfall and, in Central Nebraska, 1917–1927 (chart) ... 44
Summer Rainfall and, in Western Nebraska, 1917–1927 (chart) ... 40

PAGE

Potatoes, Average Annual Yield of, Bushels, per Acre in the Three Soil Regions of Nebraska, 1917–1927 (table) 47
Precipitation, Average Annual, of Pacific Subtropical Crops Region (map) 172
In Mauritius (chart) 339
Precise Leveling in Texas, H. G. Avers (review) 107
Prickly Pear Pest, in Australia 218
Production, Development of Sugar, in Mauritius 347
Regions of, of Potatoes, in Nebraska 37
Production and Value of Nebraska Potatoes 50
Products, of Region of Amazonian Forest and Primitive Agriculture of South America 33
Brazil Nuts 34
Rubber 33

Quarrying, Mining and, in Utah 333
Queensland, Agriculture in 122
Cotton in (map) 221
Cotton Region of 221
Cultivated Land in, 1921 (map) 121
Districts and Areas Cultivated, in (table) 122

Rabbits, in Australia 217
Spread of (1859), Cattle Tick (1880), Prickly-Pear and Wild Dog (map) 217
Radio Service Bulletin, July, 1929 (review) 107
September, October, 1929 (review) 107
Railway Communication, Necessity of, in Kenya 251
Railways of South America, Part III: Chile, W. Rodney Long (review) 418
Rain Reliability, of Australia (map) 112
Rainfall, Average Temperature and Total, May to August, and the Average Yield per Acre in the Central Climatic District of Nebraska, 1917–1927 (table) 43
Rainfall, Average Temperature, and, June to September, and Average Yield per Acre in the Northwestern Climatic District of Nebraska, 1917–1927 (table) 40
Rainfall, Average Temperature and Total, June to September, and the Average Yield per Acre in the Western Climatic District of Nebraska, 1917–1927 (table) 41
Rainfall, Erratic, of Arid Regions of the Tropics 154
Fluctuating, for Pacific Localities (graph) 161
Fluctuating, in Prominent Tropical Cities of Africa (graph) 163
Fluctuating, in Prominent Tropical Cities of Asia (graph) 155
Fluctuating, in Prominent Tropical Cities of North America (graph) 158
Fluctuating, in Prominent Tropical Cities of South America (graph) 156
Fluctuating, of Semi-Arid Regions of the Tropics 155
Fluctuating, of the Sudan North America (graph) 153
Net, of Australia (map) 227
Relation of, to the Size of Seed Potato Prices in the Dry-Land Region of Western Nebraska 42
Sharp Local Contrasts in, in the Tropics 159
Torrential Character of, in the Tropics 158
Undependable, in the Wet Tropics 155
Unfavorable Seasonal Concentration of, in the Tropics 157
Rainfall and Wind Conditions Retarding Tropical Development, Stephen S. Visher (maps and graphs) 152–166
Rainfall and Temperature, Average Annual, of Australia (map) 110
Rainfall and Temperature, Comparison of Monthly Distribution of, at Three Uganda Stations (graph) 354
Rainfall Dependability, Importance of, in the Tropics 154
Rainfall Map of Uganda 354
Rainfall Record at Osceola, Arkansas, 1892–1922 (graph) 376
Rainfall Régime, of Australia 110
Rainfall Regions, of Australia (map) 111
Ranching Industry, The, of Lower Rio Grande Valley of Texas 370
Raw-Cane Sugar, Production of, in British Empire (table) 138
Raw Sugar, Import of, into Great Britain (table) 135
Imports of, to Great Britain from British Empire (table) 137
Raw Sugar Factory, Development of, in British Empire 143
Recovery of Germany, The, James W. Angell (review) 427
Region of Amazonian Forest and Primitive Agriculture, of South America 30
Cultivated Crops of 35
Livestock in 35
Minor Forest Industries of 35
Outlook of 35
Physical Conditions of 31

PAGE

Products of 33
Regional Problems, of Lower Rio Grande Valley of Texas 371
Relief, of North Andean Crops and Grazing Region of South America 2
Relief and Soils, of Region of Amazonian Forest and Primitive Agriculture of South America 33
Religion, in Bavaria 273
Resources and Industries, of the Great Basin 325
Rice, in Guianan Littoral of South America 25
Robertson, C. J., The Sugar Industry of Mauritius (maps, charts, and illustrations) 338–352
Robins, Martha, The Recovery of Germany (review) 427
Rockland Limestone, Extent and Quality of 390
Rockland, Maine, The Lime Industry of, Grant E. Finch and George F. Howe (maps and illustrations) 389–398
Rockland, Maine, Map of, and Harbor 390
Rubber, Coffee and, Culture in Uganda 362
Rubber, of Region of Amazonian Forest and Primitive Agriculture of South America 33
Rubber Exports, of Brazil, 1870–1925 (graph) 34
Rugged Areas in Southeast Australia 133
Rum, Average Export of, from British West Indies, 1922–1926 (table) 149
Rumma, J., Grano, J. G., and Veski, J. V., Eesti. Kodu-uurimise töö (review) 421

St. Francis Basin, Land Utilization in the, Sam T. Bratton (maps, graphs, tables, and illustrations) 374–389
St. Francis Basin, Comparative Net Values of the Major Field Crops in the (table) 378
Cotton Growing District of the 376
Map of 375
Mixed Farming District of the 380
Other Uses of Unimproved Land in the 387
Sizes of Farms, and Farm Ownership, in Five Typical Counties of the (table) 377
Transitional Zone of the 383
Use of Land in Farms in the 375
Use of Land Not in Farms in the 384
Sankuri, Rainfall of, by Months, in Kenya (chart) 246
Salvador as a Market for Foodstuffs, H. P. Macgowan (review) 417
Scenery, of Bavaria 273
Science, of Bavaria 272
Seed Potato Pieces, Relation of Rainfall to the Size of, in the Dry-Land Region of Western Nebraska 42
Seismology, N. H. Heck (review) 418
Sheep, in Australia 234
In Australia, 1923 (maps) 235, 236
Shipments of Leading Vegetable Crops from Lower Rio Grande Valley of Texas (chart) 368
Shipping Centers for Nebraska Potatoes 51
Sisal, Acreage and Production of Coffee and, in Kenya (chart) 249
Of Kenya 254
Size, of Blue Grass and Nashville Basins 193
Size and General Characteristics, of Nevada 325
Of Utah 329
Size and Tenure of Farms, in Pacific Subtropical Crops Region 299
Sizes of Farms, and Farm Ownership, in Five Typical Counties, of the St. Francis Basin (table) 377
Smith, Albert C., Mountain Tops and Lowlands of Colombia (illustrations) 398–408
Smith, G. Elliot, Human History (review) 422
Social Geography, Environmental Basis of, C. C. Huntington and Fred A. Carlson (review) 209
Soil, Adjustment to, in Bavaria 261
In British Cane-Sugar Industry 139
Of Blue Grass and Nashville Basins 194
Of Volga Area and Adjacent Lands of the U. S. S. R. 58
Soil Conditions, of Western Nebraska 45
Soil Divisions of the United States, The Major, Louis A. Wolfanger (review) 207
Soils, of Australia 213
Of Mauritius Sugar Industry 342
Of New South Wales (map) 214
Of Pacific Subtropical Crops Region 176
Relief and, of Region of Amazonian Forest and Primitive Agriculture of South America 33
South Africa, Dried Fruit Industry and Trade of, Cecil M. P. Cross (review) 205
South America, Agricultural Regions of: Instalment VII, Clarence F. Jones (maps, graphs, and illustrations) 1–37
South America, Clarence F. Jones (review) 424
Distribution of Cattle in (map) 22
Fluctuating Rainfall for Prominent Tropical Cities in (graph) 156
Markets for Rubber Sundries and Specialties in 104
South Australia, Agricultural Regions in 127
Cultivated Land in, 1923 (map) 127

PAGE

Southeast Australia, Rugged Areas in 133
Special Conditions Affecting Agriculture, in Australia 130
Speek, Peter A., Eesti. Kodu-uurimise töö (review) 421
Tartu (review) 424
Spence, Vina E., A New Regional Geography of the World (review) 211
Stamp, L. Dudley, Asia, An Economic and Regional Geography (review) 206
Stock, in Crop-Pasture and Pasture-Crop Regions in Southeast, of Australia 239
In Pasture-Bush Region of Australia 241
In Pasture Region of Australia 242
Stock Raising, in the Dry Region of the U. S. S. R. 79
Stone Quarrying, in Forest of Dean in Gloucestershire 317
Strong, Helen M., Air Marking (review) 107
Airports in Latin America (review) 416
Analyses of Maryland Coals (review) 205
Annual Report of Commissioner of Lighthouses to Secretary of Commerce for Fiscal Year Ended June 30, 1929 (review) 107
Annual Report of Director of Bureau of Foreign and Domestic Commerce to Secretary of Commerce for Fiscal Year Ended June 30, 1929 (review) 104
Bowie Method of Triangulation Adjustment, The (review) 205
British Trade in Rubber and Rubber Products (review) 105
Cattle Raising in Argentina (review) 105
Coffee Industry of Brazil (review) 416
Commerce Yearbook, 1929, Vols. 1 and 2 (review) 104
Distances Between United States Ports (review) 205
Dried Fruit Industry and Trade of South Africa (review) 205
Employment for Americans in Latin America (review) 418
Finland: An Economic Review (review) 416
Fishery Industries of the United States, 1928 (review) 205
Foreign Trade in Fresh Fruits (review) 204
Foreign Trade of the United States in the Calendar Year 1919 (review) 416
Fruit Markets in Eastern Asia (review) 418
Hydrography (review) 418
Index to Commerce Reports, Nos. 26–39, Volume 3, Thirty-Second Year, July–September, 1929 (review) 104
Index to Commerce Reports, Nos. 1–13, Vol. 1, Thirty-Third Year, January–March, 1930 (review) 418
Industrial Structure of New England (review) 416
Inland-Waterway Freight Transportation Lines in the United States (review) 416
Installment Selling of Automobiles in Oceania, Asia, and Africa (review) 417
Instructions, Primary Tide Stations (review) 107
Leather Trade of Egypt (review) 105
Manual of First-Order Leveling (review) 107
Margarine Industry of Europe, The (review) 205
Market Data Handbook of the United States, The (review) 204
Market for Foodstuffs in Guatemala (review) 417
Market for Sawmill and Woodworking Machinery in Mexico, Guatemala, Panama, Cuba, and Porto Rico (review) 205
Marketing of Nickel (review) 417
Marketing of Tungsten Ores and Concentrates (review) 105
Markets for Building Materials: Part II, Mexico, Central America, and West Indies (review) 104
Markets for Fruit Juice and Fruit Sirups in Continental Europe (review) 416
Markets for Fuel-Oil Burners in the Eastern Hemisphere (review) 205
Markets for Sawmill and Woodworking Machinery in Scandinavia and the Baltic States (review) 417
Markets for Sawmill and Woodworking Machinery in South America (review) 417
Markets of Foodstuffs in Guatemala, The (review) 205
Monthly Summary of Foreign Commerce of United States, July, August, and September, 1929 (review) 104
Motorization of North Africa (review) 416
Ocean Routes in United States Foreign Trade (review) 416
Port of Hamburg, The (review) 204
Port of Liverpool, Including Birkenhead and Garston, The (review) 204
Port Studies in Coöperation Between the Bureau of Foreign and Domestic Commerce and U. S. Shipping Board (review) 204
Precise Leveling in Texas (review) 107
Radio Service Bulletin, July, 1929 (review) 107

PAGE

Radio Service Bulletin, September, October, 1929 (review) 107
Railways of South America: Part II—Chile (review) 418
Salvador as a Market for Foodstuffs (review) 417
Seismology (review) 418
South American Markets for Rubber Sundries and Specialties (review) 104
Summarized Data of Land Production (review) 205
Survey of Current Business, February, 1930 (review) 204
Survey of Non-utilized Wood in North Carolina (review) 107
Tidal Bench Marks, State of Massachusetts (review) 107
Tide Tables, United States and Foreign Ports for Year 1930 (review) 107
Structure, of Forest of Dean in Gloucestershire 309
Subsistence Agriculture, Present Types of, in Uganda 355
Subsistence Farming, Early Development of, in Uganda 353
Suburban Trend, The, Harlan Paul Douglass (review) 208
Sudan North Africa, The Fluctuating Rainfall of the (graph) 153
Sugar, Average Export of, from British West Indies, 1922–1926 (table) 149
In North Andean Crops and Grazing Region of South America 9
Sugar Beet, Production of, 1925, in Germany (map) 87
Sugar Cane, Distribution of, in Mauritius 338
In Guianan Littoral of South America 24
Relation of Growth of, to Climatic Conditions 338
Relation of Growth of, to Temperature (chart) 340
Tonnage of, Per Arpent, on Estates (chart) 347
Sugar Cane Cultivation, 1923, in Australia (map) 219
Sugar Cane Production, of Australia, 1925 (map) 146
Of Natal (map) 141
Sugar Exports of Germany and Czecho-Slovakia (graph) 92
Of Mauritius, 1884–1926 (graph) 140
Sugar Industry of Mauritius, The, C. J. Robertson (maps, charts, and illustrations) 338–352
Sugar Produced from German Seed, 1913 (table) 91
Sugar Production, 1915–1916, to 1926–1927, in British Empire (graph) 136
Sugar Production, in Certain Countries of British Empire (chart) 138
In Mauritius, 1920–1924 (map) 339
In Mauritius (chart) 343
Of the World, 1855–1926 (chart) 82
Summarized Data of Lead Production, Lewis A. Smith and Others (review) 205
Summer Rainfall and Potato Production in Central Nebraska, 1917–1927 (chart) 44
Summer Rainfall and Potato Production in Northwestern Nebraska, 1917–1927 (chart) 41
Summer Rainfall and Potato Production in Western Nebraska, 1917–1927 (chart) 40
Sunshine Record, at Osceola, Arkansas, 1892–1922 (graph) 376
Survey of Current Business, February, 1930 (review) 204
Survey of Non-utilized Wood in North Carolina (review) 107
Systems of Farming, in Pacific Subtropical Crops Region 294
Shifts in 181

Taliaferro, Rebecca M., Ends of the Earth (review) 210
Tartu, Editorial Staff of Committee on Study of the City (review) 424
Tasmania, Agricultural Land of (map) 126
Agricultural Regions of 126
Growth of Cereals, Rootcrops, Fruits, and Vegetables in (map) 227
The Cool Temperate State 229
Tasmanian Crops in 1922–1923 (table) 127
Taylor, Griffith, Agricultural Regions of Australia: Instalment I (maps, tables, and illustrations) 109–135
Agricultural Regions of Australia: Instalment II (maps, tables, and illustrations) 213–243
Temperature and Rainfall, Average, June to September, and Average Yield per Acre in the Northwestern Climatic District of Nebraska, 1917–1927 (table) 40
Temperature, Average, and Total Rainfall, May to August, and the Average Yield per Acre in the Central Climatic District of Nebraska, 1917–1927 (table) 43
June to September, and the Average Yield per Acre in the Western Climatic District of Nebraska, 1917–1927 (table) 41
Tenure, Size and, of Farms, in Pacific Subtropical Crops Region 299

PAGE

Texas, Lower Rio Grande Valley of, William T. Chambers (maps, charts, and illustrations) 364–374
Tidal Bench Marks, State of Massachusetts, L. A. Cole (review) 107
Tide Tables, United States and Foreign Ports for Year 1930 (review) 107
Tillage, Improved Technique of, in the Dry Region of the U. S. S. R. 69
Timber, in Forest of Dean in Gloucestershire 315
Tobacco, in North Andean Crops and Grazing Region of South America 9
Tobacco Production, 1924, in Blue Grass and Nashville Basins (map) 201
Topographical Map of Forest of Dean in Gloucestershire 310
Topography, of Pacific Subtropical Crops Region 175
Topography, of Vicinity of Stow, Massachusetts (maps) 408, 409
  Glacial Features 408
  Glacio-Fluviatile Features 409
Topography, Physiography and, of Blue Grass and Nashville Basins 191
Torgasheff, Boris P., The Mineral Industry of the Far East (review) 426
Transitional Zone, of the St. Francis Basin 383
Transportation, in the Great Basin 335
  Methods of, in Lime Industry of Rockland, Maine .. 394
Tropics, Erratic Rainfall of Arid Regions of the 154
  Fluctuating Rainfall of Semi-Arid Regions of the ... 155
  Hurricanes and the Race Problem in the 164
  Importance of a Fuller Knowledge of Climatic Conditions in the 153
  Importance of Rainfall Dependability in the 154
  Other Deterrents to Civilization in the 153
  Other Indirect Effects of Cyclones in the 163
  Sharp Local Contrasts in Rainfall in the 159
  Torrential Character of Rainfall in the 158
  Undependable Rainfall in the Wet 155
  Unfavorable Seasonal Concentration of Rainfall in the 157
  Wind Storms as Retarding Influences in the 160
Tuft's Level, in Forest of Dean in Gloucestershire (chart) 312
Tulaikov, N. M., Agriculture in the Dry Region of the U. S. S. R. (maps, tables, and illustrations) 54–81

U. S. S. R., Agriculture in the Dry Region of the, N. M. Tulaikov (maps, tables, and illustrations) ..54–81
Uganda, Agriculture and Commerce of, Earl C. Case (maps, graphs, and illustrations) 352–364
Uganda, Acreage of Principal Crops in (graph) 356
  Cereal Belt of 357
  Commercial Crops of 359
  Cotton Culture and Social Conditions of 361
  Distribution of Millet Culture of (map) 355
  Distribution of Plantain Culture of (map) 355
  Early Development of Subsistence Farming in 353
  Outlook of Agriculture and Commerce of 363
  Pastoral Belt of 359
  Place Map of 353
  Plantain Belt of 355
  Plantation Agriculture of Europeans in 362
  Present Types of Subsistence Agriculture in 355
  Rainfall Map of 354
Uganda Protectorate, Exports of, 1927 (graph) 358
United States, The Major Soil Divisions of the (review) 208
United States Ports, Distances Between (review) 205
Uses, Other, of Unimproved Land, in St. Francis Basin 387
Utah, Agriculture of 331
  Forests of 334
  Livestock of 332
  Manufacturing in 325
  Mining and Quarrying in 333
  Population of 330
  Size and General Characteristics of 329

Value, Production and, of Nebraska Potatoes 50
Vegetable Crops, Early, of Lower Rio Grande Valley of Texas 364
Vegetables Grown for Sale, Acreage of, 1919, in Pacific Subtropical Crops Region (map) 290

PAGE

Vegetables, in Pacific Subtropical Crops Region 285
  Increase in Fruits and, in Pacific Subtropical Crops Region 182
  Increase of Car-lot Shipment of, from Lower Rio Grande Valley of Texas (chart) 367
  Shipments of Leading, from Lower Rio Grande Valley of Texas (chart) 368
Vegetation, in the Pacific Subtropical Crops Region (map) 170
  Of North Andean Crops and Grazing Region of South America 4
  Of Region of Amazonian Forest and Primitive Agriculture of South America 32
Verrill, A. Hyatt, Old Civilizations of the New World (review) 425
Veski, J. R., Rumma, J., Grano, J. G. and, Eesti. Kodu-uurimise töö (review) 421
Victoria, Agricultural Regions in 125
  Agriculture in, 1923–1924 (map) 125
  Generalized Table, Showing Crops Grown in Districts in (table) 126
  Irrigation in 215
  (map) 216
Visher, Stephen S., Rainfall and Wind Conditions Retarding Tropical Development (maps and graphs) 152–166
Volga Area and Adjacent Lands of the U. S. S. R., Causes of Crop Failure in the 65
  Principal Characteristics of the 57
Volga Area of the U. S. S. R., Principal Characteristics of the, and Adjacent Lands 57

Wajir, Rainfall of, by Months, in Kenya (chart) 246
Walnuts, Approximate Acreage of Pecans, and Almonds, 1919, in Pacific Subtropical Crops Region (map) 288
Water Power, of Bavaria 269
West, Anthony J., Raw Materials of Industrialism (review) 207
Western Australia, Agricultural Regions of (map) ..129–130
Western Climatic District of Nebraska, Average Temperature and Total Rainfall, June to September, and the Average Yield per Acre in, 1917–1927 (table) 41
Western District, of Western Nebraska 41
Western Nebraska, Relation of Rainfall to the Size of Seed Potato Pieces in the Dry-Land Region of 42
  Soil Conditions of 45
  Summer Rainfall and Potato Production in, 1917–1927 (chart) 40
  Western District of 41
Western Region, of Nebraska 39
  Northwestern District 39
  Western District 41
Wheat, in Australia 223
  Climatic Control of Production of, in Australia (map) 224
Wheat Acreage, Maize and, and Production, in Kenya (chart) 250
Wild-Dog, in Australia 218
Wild-Dog, Spread of Rabbits (1859), Cattle Tick (1880), Prickly-Pear and, in Australia (map) 217
Wills, L. J., The Physiographical Evolution of Britain (review) 210
Wind Conditions, Rainfall and, Retarding Tropical Development, Stephen S. Visher (maps and graphs) 152–166
Wind Storms as Retarding Influences, in Tropics 160
  Thunderstorm Squalls 160
  Tornadoes and Related Storms 160
  Tropical Cyclones: Hurricanes and Typhoons 160
Wolfanger, Louis A., The Major Soil Divisions of the United States (review) 207
World, Economic Resources and Industries of the, Isaac Lippincott (review) 206
World Sugar Production, 1855–1926 (chart) 82
Wright, Alfred J., The Farm Export Debenture Plan (review) 420

Yoder, F. R., Introduction to Agricultural Economics (review) 419

Zeller, Rose, The Major Soil Divisions of the United States (review) 208

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